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DRAFT FISHERY DESCRIPTION FOR THE PACIFIC COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

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By

David Ainley, Bob DeLong, Sam Herrick,
Larry Jacobson, Eddy Konno, John Lanfersieck,
Mark Lowry, Richard Parrish, Cynthia Thomson and Patricia Wolf

ADMINISTRATIVE REPORT LJ-93-15

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**DRAFT FISHERY DESCRIPTION FOR THE PACIFIC COASTAL PELAGIC SPECIES
FISHERY MANAGEMENT PLAN**

July 12, 1993

Coastal Pelagic Species Fishery Management Plan Development Team
and Contributing Experts¹

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¹Preparers: David Ainley (Pt. Reyes Bird Observatory), Bob DeLong (NMML), Sam Herrick (SWFSC), Larry Jacobson (SWFSC), Eddy Konno (CDFG), John Lanfersieck (SWFSC), Mark Lowry (SWFSC), Richard Parrish (PFEG), Cynthia Thomson (SWFSC), and Patricia Wolf (CDFG).



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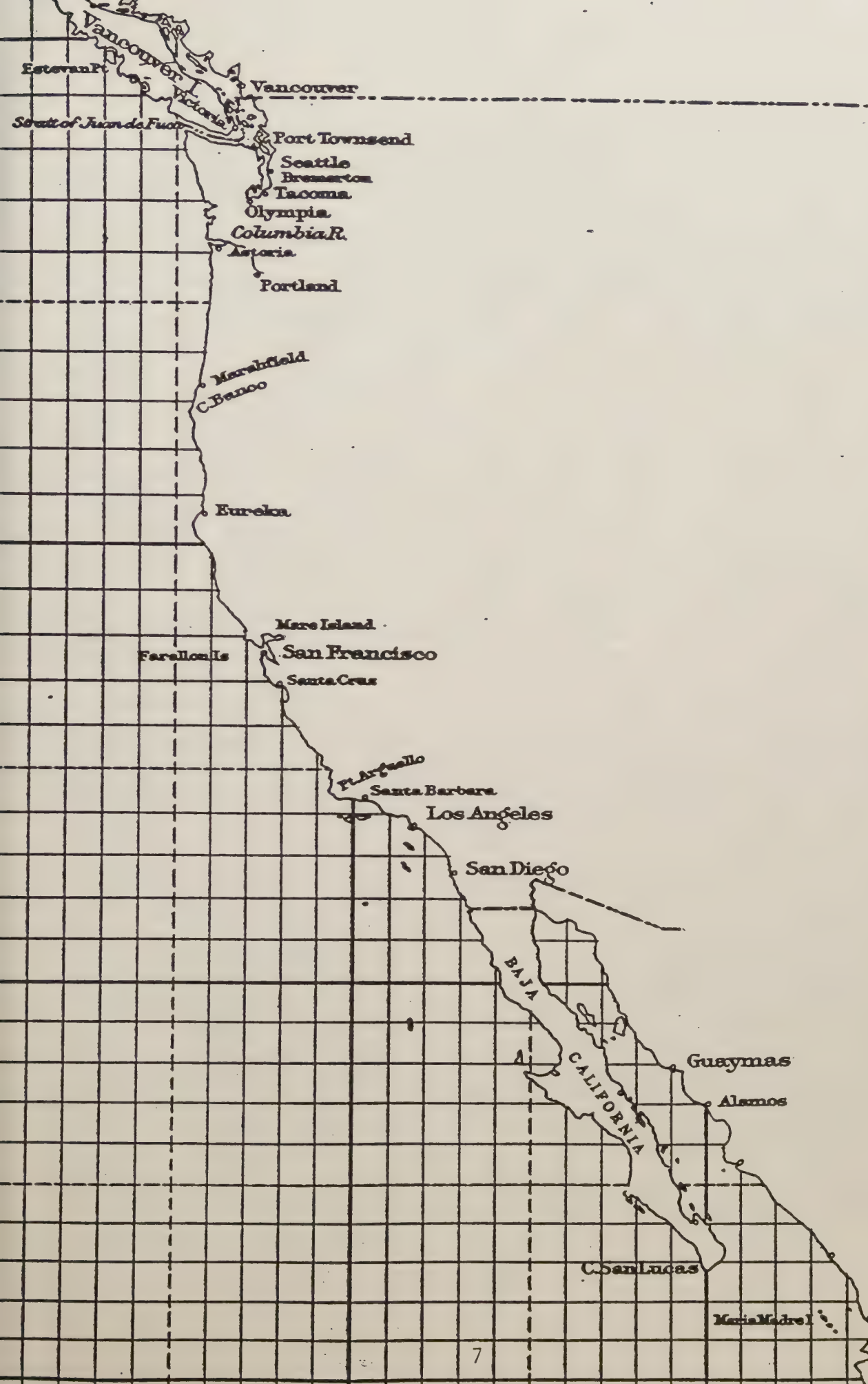
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1.0 - Description of the Coastal Pelagics Fishery

The fishery for coastal pelagic species (CPS) consists of fish stocks and parties involved in their commercial harvest, commercial use, recreational harvest and recreational use. Table 1.0-1 lists the coastal pelagic species that are currently or could potentially be harvested with pelagic or midwater fishing gear. Not all of those species are, however, managed under this fisheries management plan (FMP) or by the Pacific Fishery Management Council (PFMC). This FMP covers jack mackerel, Pacific mackerel, Pacific sardine and northern anchovy only. Widow rockfish, shortbelly rockfish and Pacific whiting are currently managed under the FMP for Pacific coast groundfish (PFMC 1990a) but may become important in the future development of the CPS fishery. Market squid, Pacific saury, Pacific herring and Pacific bonito are not currently managed by PFMC but could be managed under this FMP in the future.

Most CPS and the fishing they support are distributed internationally, with components in the exclusive economic zones of Canada and Mexico as well as in international waters outside the U.S. exclusive economic zone (EEZ). Individual components of the CPS fishery include or may include U.S. commercial fisheries; foreign catcher and processor vessels in U.S., Mexican, Canadian and international waters; foreign vessels engaged in joint ventures (JV's) with domestic commercial vessels; party and charter boats; and anglers who target coastal pelagic species or use them as bait. No Indian fisheries would be affected by this management plan.

Coastal pelagic species are taken directly or as bycatch in fisheries that use many types of gear and vessels. Gears used to harvest CPS by directed fishing are primarily midwater trawls, pelagic trawls, purse seines, drum seines, lampara nets and dip nets. CPS are taken incidentally with gill nets, trammel nets, trolls, pots, hook and line, and jigs.

Table 1.0-1. Coastal pelagic species

Pacific saury	<u>Cololabis saira</u>
Northern anchovy*	<u>Engraulis mordax</u>
Market squid	<u>Loligo opalescens</u>
Pacific whiting (hake)	<u>Merluccius productus</u>
Pacific bonito	<u>Sarda chiliensis</u>
Pacific herring	<u>Clupea harengus</u>
Pacific sardine*	<u>Sardinops sagax</u>
Pacific (chub or blue) mackerel*	<u>Scomber japonicus</u>
Widow rockfish	<u>Sebastes entomelas</u>
Shortbelly rockfish	<u>Sebastes jordani</u>
Jack (Spanish) mackerel*	<u>Trachurus symmetricus</u>

*Fisheries to be managed under this plan.

1.1 - Northern Anchovy

Information about the biology of northern anchovy is available in Frey 1971; PFMC 1983 and 1990a; and in the references cited in the following sections.

1.1.1 - Distribution and Habitat

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California. The population is divided into northern, central and southern subpopulations, or stocks. The central subpopulation, which supports significant commercial fisheries in the United States and Mexico, ranges from approximately San Francisco, California, to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico, in the south. The northern subpopulation supports a small but locally important bait fishery in Oregon and California.

Northern anchovies in the central subpopulation are typically found in waters that range from 12° to 21.5° C. There is a great deal of regional variation in age composition and size, with older and larger anchovies found farther offshore and to the north (Parrish 1985). The pattern is accentuated in warm years and during the summer (Methot 1989).

1.1.2 - Life History

Northern anchovies are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed 4 years of age and 18 cm total length, although individuals as old as 7 years and 23 cm have been recorded. Natural mortality is thought to be $M = 0.6$ to 0.8 yr^{-1} , which means that 45% to 55% of the total stock would die each year of natural causes if no fishing occurred. Northern anchovy eat plankton by either filter feeding or biting, depending on the size of the food.

Anchovy spawn during every month of the year, but spawning increases in late winter and early spring and peaks from February to April. Females spawn batches of eggs throughout the spawning season at intervals as short as seven to ten days. The eggs, found near the surface, are typically ovoid and translucent and require two to four days to hatch, depending on water temperatures. Both the eggs and larvae are found near the surface. Anchovy are all sexually mature at age 2. The fraction of 1-year-olds that is sexually mature in a given year depends on water temperature and has been observed to range from 47% to 100% (Methot 1989).

Northern anchovy are subject to natural predation throughout all life stages. Eggs and larvae fall prey to an assortment of invertebrate and vertebrate planktivores. As juveniles in nearshore areas, anchovies are vulnerable to a variety of predators, including some recreationally and commercially important

species of fish. As adults offshore, anchovies are fed upon by numerous fishes (some of which have recreational and commercial value), mammals, and birds—including the endangered California brown pelican (Pelecanus occidentalis californicus) and least tern (Sterna albifrons browni). Possible links between brown pelican breeding success and anchovy abundance have been documented (Anderson et al. 1980, 1982; Jacobson and Thomson 1989). Other species known or suspected to feed on northern anchovy are listed in Table 1.1.2-1.

Table 1.1.2-1. Known or suspected predators of northern anchovy

MARINE MAMMALS

<u>Callorhinus ursinus</u>	Northern fur seal
<u>Arctocephalus townsendi</u>	Guadalupe fur seal
<u>Eumetopias jubatus</u>	Steller's sea lion
<u>Zalophus californianus</u>	California sea lion
<u>Mirounga angustirostris</u>	Northern elephant seal
<u>Phoca vitulina</u>	Harbor seal
<u>Delphinus delphis bairdi</u>	Common dolphin
<u>Phocoena phocoena</u>	Harbor porpoise
<u>Phocoenoides dalli</u>	Dall's porpoise
<u>Lagenorhynchus obliquidens</u>	Pacific white-sided dolphin
<u>Tursiops truncatus</u>	Bottlenose dolphin
<u>Globicephala macrorhynca</u>	Pilot whale
<u>Balaenoptera musculus</u> *	Blue whale*
<u>Balaenoptera physalus</u> *	Fin whale*
<u>Balaenoptera borealis</u>	Sei whale
<u>Balaenoptera acutorostrata</u>	Minke whale
<u>Balaena glacialis</u> *	Pacific right whale*
<u>Megaptera novaeangliae</u> *	Humpback whale*
<u>Eschrichtius robustus</u> *	California grey whale*

MARINE BIRDS

<u>Diomedea nigripes</u>	Black-footed albatross
<u>Fulmarus glacialis</u>	Fulmar
<u>Puffinus griseus</u>	Sooty shearwater
<u>Puffinus puffinus</u>	Manx shearwater
<u>Oceanodroma leucorhoa</u>	Leach's petrel
<u>Oceanodroma homochroa</u>	Ashy petrel
<u>Loomelania melania</u>	Black petrel
<u>Pelecanus occidentalis</u> *	Brown pelican*
<u>Phalacrocorax auritus</u>	Double-crested cormorant
<u>Phalacrocorax penicillatus</u>	Brandt's cormorant
<u>Phalacrocorax pelagicus</u>	Pelagic cormorant
<u>Larus glaucescens</u>	Glaucous-winged gull
<u>Larus occidentalis</u>	Western gull
<u>Larus heermanni</u>	Heerman's gull
<u>Larus delawarensis</u>	Ring-billed gull
<u>Larus californicus</u>	California gull
<u>Rissa tridactyla</u>	Black-legged kittiwake
<u>Uria aalge</u>	Common murre
<u>Cepphus columba</u>	Pigeon guillemot
<u>Brachyramphus marmoratum</u>	Marbled murrelet
<u>Endomychura craveri</u>	Craveri's murrelet
<u>Endomychura hypoleuca</u>	Xantu's murrelet
<u>Synthliboramphus antiquum</u>	Ancient murrelet
<u>Ptychoramphus aleutica</u>	Cassin's auklet
<u>Cerorhinca monocerata</u>	Rhinoceros auklet
<u>Fratercula corniculata</u>	Horned puffin
<u>Lunda cirrhata</u>	Tufted puffin
<u>Haliaeetus leucocephalus</u> *	Bald eagle*
<u>Pandion haliaetus</u>	Osprey

Sterna elegans
Sterna caspia
Sterna forsteri
Sterna albifrons browni*
 MARINE FISHES
Engraulis mordax
Sardinops sagax caeruleus
Merluccius productus
Alopias vulpinus
Isurus oxyrinchus
Galeorhinus zyopterus
Prionace glauca
Torpedo californica
Oncorhynchus kisutch
Oncorhynchus tshawytscha
Sebastes spp.
Roccus saxatilis
Paralabrax nebulifer
Paralabrax clathratus
Caulolatilus princeps
Trachurus symmetricus
Seriola dorsalis
Atractoscion (Cynoscion)
nobilis
Seriphus politus
Menticirrhus undulatus
Genyonemus lineatus
Embiotocidae spp.
Sphyraena argentea
Scomber japonicus
Sarda chiliensis
Thunnus alalunga
Thunnus thynnus
Xiphias gladius
Tetrapturus audax
Paralichthys californicus
 INVERTEBRATES
Loligo opalescens
Decapoda (oegopsida)

Elegant tern
 Caspian tern
 Forster's tern
 Least tern*
 Northern anchovy
 Pacific sardine
 Pacific whiting
 Common thresher shark
 Bonito shark
 Soupfin shark
 Blue shark
 Pacific electric ray
 Silver salmon
 King salmon
 Rockfishes (many species)
 Striped bass
 Barred sand bass
 Kelp bass
 Ocean whitefish
 Jack mackerel
 Yellowtail
 White seabass
 Queenfish
 California corbina
 White croaker
 Surfperches (many species)
 California barracuda
 Pacific mackerel
 Pacific bonito
 Albacore
 Bluefin tuna
 Swordfish
 Striped marlin
 California halibut
 Market squid
 Oceanic squids

*An endangered species.

1.1.3 - Abundance, Recruitment and Population Dynamics

Information about changes in anchovy abundance from 1780 to 1970 is available from scale counts taken from sediment cores obtained from the Santa Barbara and Soledad basins off California (Soutar and Issacs 1969, 1974). These data indicate that significant anchovy populations existed throughout the period and that biomass levels during the late 1960s were modest relative to levels during most of the 19th and early 20th centuries. Scale counts indicated that northern anchovy varied less over time than Pacific sardine.

Recent biomass estimates for the central subpopulation of northern anchovy from 1964 to 1991 (Jacobson and Lo 1991) indicate that biomass averaged 443,000 metric tons (MT) until 1970, increased rapidly to 1,766,000 MT in 1974, and then declined to 569,000 MT in 1978 (Table 1.1.3-1 and Figure 1.1.3-1). Biomass declined to about 265,000 MT by 1991.

Recruitment of northern anchovy is more variable than for most clupeoid fish (Beddington and Cooke 1983; Myers et al. 1990). The standard deviation of annual log scale recruitment estimates for northern anchovy from 1964 to 1990 was 0.71 (Jacobson and Lo 1991). Strong year classes were observed in about seven years during that period (Table 1.1.3-1).

The age at which northern anchovy become vulnerable to fishing depends on location and type of fishery. They probably become vulnerable to the live bait fishery at an earlier age than to the reduction fishery. Substantial numbers of zero and one-year-old fish are taken by both fisheries in most years.

Maximum sustainable yield (MSY) for northern anchovy in the central subpopulation is estimated to be 123,000 MT per year at a total biomass level of about 733,000 MT (Conrad 1991). As for other pelagic species, MSY should be viewed as a rough indicator of stock productivity or long-term average harvest potential rather than as a management goal, because stock size and potential catches may vary dramatically from year to year (Beddington and May 1977).

1.1.4 - Fishery Utilization

Northern anchovy in the central subpopulation are harvested by commercial fisheries in California and Mexico for reduction, human consumption, live bait, dead bait and other nonreduction commercial uses. Anchovy landed in Mexico are used primarily for reduction, although small amounts are probably used as bait. Small quantities of the northern subpopulation are taken off Oregon and Washington for use as dead bait. Anchovy catch and landings data are given in Tables 2.1.1-1 and 2.1.1-5.

Anchovy landed by the reduction fisheries are converted to meal, oil and soluble protein products sold mainly as protein supplements for poultry food and also as feed for pigs, farmed fish, fur-producing animals, laboratory animals and household pets. Meal obtained from anchovy is about 65% protein (meal from other fishes is 50%-55% protein).

Anchovy harvested by the live bait fishery are not landed but are kept alive for sale to anglers as bait and chum. Transactions between buyers and sellers of live bait take place either at sea or at bait wells tied up at docks. Bait dealers generally supply partyboats on a contract basis and receive a percentage of the fees paid by passengers. Bait is also sold by the scoop to anglers in private vessels.

Anchovy landed by the nonreduction (other than live bait) fishery are used as dead frozen bait, fresh fish for human consumption, canned fish for human consumption, animal food, and anchovy paste.

1.1.5 - Current Management

As of December 31, 1992, northern anchovy were managed by the Pacific Fishery Management Council under the Northern Anchovy FMP. The Northern Anchovy FMP was first adopted during 1978; management before then was by the state of California. Detailed descriptions of the management of northern anchovy are given in PFMC (1983 and 1990a).

Table 1.1.3-1. Total biomass (MT), spawning biomass and recruitment estimates (10^3 age-0 fish on July 1) for northern anchovy, 1964 to 1991

<u>Year</u>	<u>Total</u>	<u>CV^a</u>	<u>Spawning</u>	<u>CV</u>	<u>Recruits</u>	<u>CV</u>
1964	341,640	0.217	341,630	0.215	60,881	0.475
1965	563,380	0.239	304,060	0.187	21,640	0.431
1966	567,990	0.232	512,300	0.241	21,974	0.348
1967	497,530	0.223	455,880	0.229	17,432	0.391
1968	415,700	0.224	403,100	0.224	16,101	0.297
1969	361,510	0.210	343,920	0.213	25,221	0.420
1970	353,910	0.226	270,910	0.221	29,497	0.419
1971	353,910	0.251	213,140	0.296	84,083	0.457
1972	724,430	0.318	276,880	0.261	115,948	0.315
1973	1,219,800	0.229	1,192,700	0.229	150,000	0.270
1974	1,766,100	0.160	1,043,200	0.216	55,421	0.435
1975	1,611,800	0.145	1,358,700	0.164	28,567	0.333
1976	1,275,300	0.164	1,201,600	0.166	23,896	0.323
1977	790,830	0.181	790,320	0.181	38,525	0.472
1978	568,970	0.185	567,080	0.185	40,117	0.389
1979	527,620	0.188	425,550	0.189	150,000	0.092
1980	799,730	0.061	787,340	0.062	35,353	0.192
1981	661,660	0.062	644,390	0.060	46,262	0.153
1982	459,500	0.070	394,450	0.065	85,036	0.069
1983	557,560	0.053	540,220	0.053	11,620	0.285
1984	319,300	0.074	317,340	0.073	89,938	0.112
1985	649,720	0.083	485,730	0.074	63,374	0.225
1986	698,590	0.127	690,820	0.127	28,672	0.217
1987	566,640	0.142	561,460	0.142	21,279	0.326
1988	329,050	0.221	299,910	0.210	35,384	0.236
1989	341,790	0.214	188,490	0.268	19,514	0.375
1990	299,410	0.248	283,650	0.245	16,715	0.898
1991	265,340	0.41	260,980	0.400		

All quantities were estimated using a stock synthesis model (Jacobson and Lo 1991).

^a The coefficient of variation.

ANCHOVY BIOMASS ESTIMATES, 1964-1991

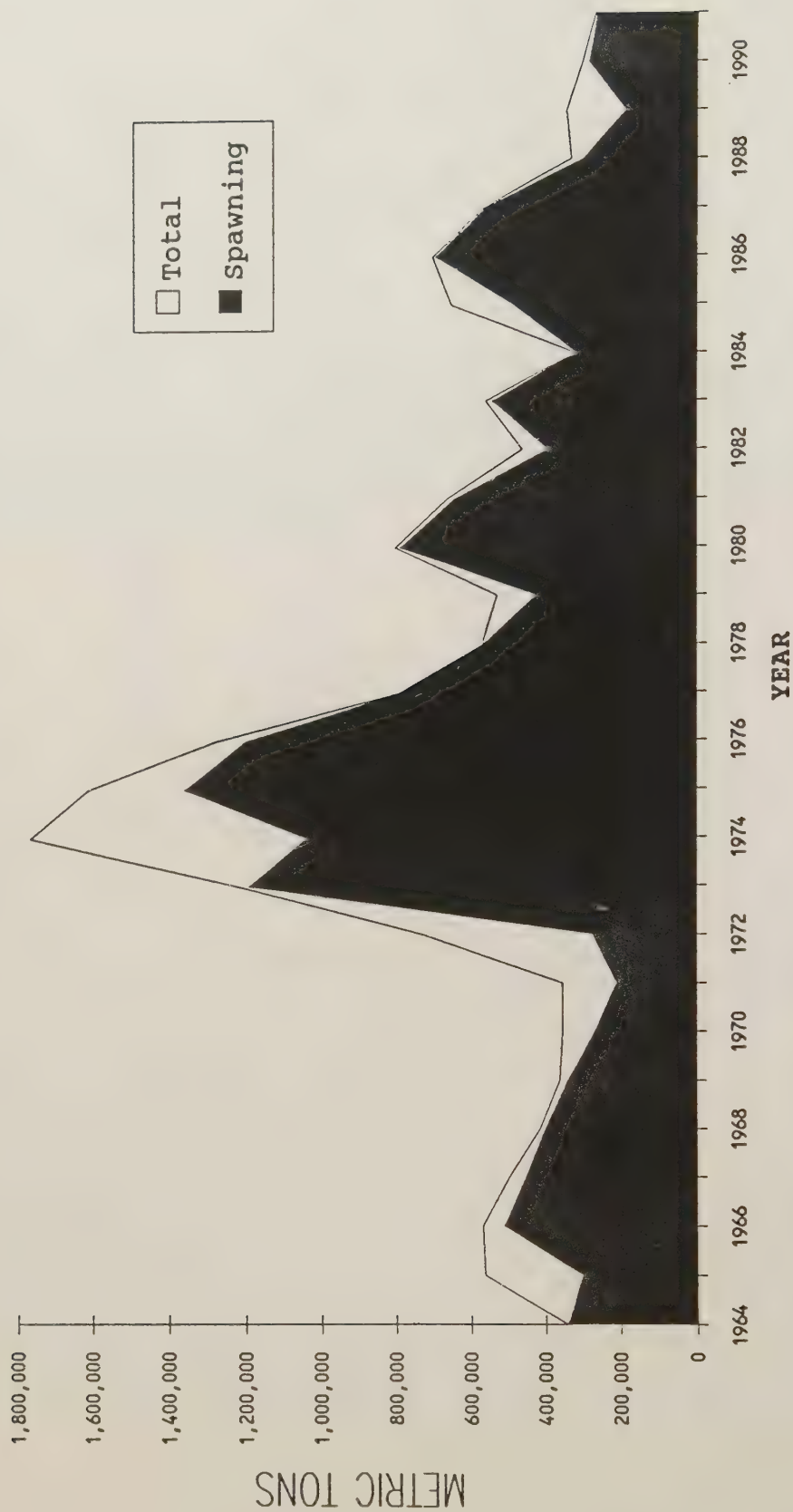


Figure 1.1.3-1. Spawning and total (age 1+) biomass estimates for northern anchovy during 1964 to 1991.

1.2 - Jack Mackerel

Detailed information about the biology of jack mackerel is available in MacCall et al. 1980 and MacCall and Stauffer 1983 and in the references cited in the following sections.

1.2.1 - Distribution and Habitat

Jack mackerel range widely throughout the northeastern Pacific, from the Pacific coast to an offshore limit approximated by a line running from Cabo San Lucas, Baja California, to the eastern Aleutian Islands, Alaska. Much of the range lies outside the 200-mile U.S. EEZ.

Although there is little evidence of subpopulations, small jack mackerel (10 to 30 cm FL and up to 8 years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Older, larger fish (50 to 60 cm FL and 16 to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the northern coastline. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 to 50 cm TL; 9 to 15 years of age) were recently found in considerable numbers around the 200-mile limit of the U.S. EEZ off southern California (SWFSC 1991).

Jack mackerel off southern California move inshore and offshore as well as north and south. The fish are more available on offshore banks in late spring, summer and early fall than during the remainder of the year.

In southern California waters, jack mackerel schools are often located over rocky banks, artificial reefs and shallow rocky coastal areas. They remain near the bottom or under kelp canopies during daylight and venture into deeper surrounding areas at night. Young juvenile fish sometimes form small schools beneath floating kelp and debris in the open sea.

1.2.2 - Life History

Jack mackerel grow to about 60 cm and may live for 30 years or longer. Estimates of natural mortality are uncertain, but the natural mortality rate (M) averaged over the life span of a typical fish is probably less than 0.25 yr^{-1} , which means that about 22% of the total stock would die each year of natural causes if no fishing occurred.

Small jack mackerel taken off southern California and northern Baja California eat macroplankton (copepods, pteropods and euphausiids), juvenile squid and anchovy. The larvae feed almost entirely on copepods.

Although immature jack mackerel can be found off southern California at all times of the year, 50% or more of all females reach sexual maturity during their first year of life. Young jack

mackerel spawn fewer times and smaller batches of eggs than do older fish.

The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July (MacCall and Prager 1988). Young spawners off southern California begin spawning later in the year than older spawners. Little is known of the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly waters.

Jack mackerel may be a major source of forage for billfish but are probably a minor source for smaller predators. Of course, jack mackerel may be a major food item at specific times and places for any predators large enough to eat them.

Adult jack mackerel probably do not contribute significantly to food supplies of marine birds because they are too large to be ingested by most bird species and tend to school inaccessibly deep. Brown pelicans have been observed feeding on fish presumed to be jack mackerel, but studies of stomach contents have not revealed jack mackerel remains. It seems unlikely that the abundance of jack mackerel significantly influences brown pelican populations.

Little information is available on predation of jack mackerel by marine mammals. Food analyses indicate that jack mackerel are not often eaten by California sea lions, Zalophus californianus, or northern fur seals, Callorhinus ursinus.

1.2.3 - Abundance, Recruitment and Population Dynamics

The best current estimate of average spawning biomass for jack mackerel, based on California Cooperative Oceanic Fisheries Investigations (CalCOFI) data, is about 1.2 to 2.6 million MT, with roughly 50% of the total spawning biomass found off California and Mexico. This estimate, which is based on scanty information about the distribution and reproductive biology of jack mackerel, is little more than an educated guess.

CalCOFI ichthyoplankton surveys and fish-spotter data are the only available sources of information about year-to-year changes in abundance of jack mackerel (Table 1.2.3-1). Neither CalCOFI surveys or fish spotters cover the entire range of the population, so relationships between the indices and biomass may be obscured.

MacCall and Prager (1988) used general linear models and analysis of variance with CalCOFI data to estimate relative abundance of jack mackerel larvae from 1950 to 1980. Their analysis refined and extended earlier work by MacCall and Stauffer (1983). The index of relative abundance for jack mackerel larvae shows considerable year-to-year fluctuation but no long-term trends (Figure 1.1.3-1).

Two indices of relative abundance from fish-spotter data for 1963 to 1990 are available for jack mackerel: a catch-per-unit-effort-like index (Jim Squires, NMFS, Southwest Fisheries Science Center, pers. comm.) and an index based on general linear models and analysis of variance (N. C. H. Lo, NMFS, Southwest Fisheries Science Center, pers. comm.). The catch-per-unit-effort-like index was calculated from data collected by pilots flying at night over

a "core" area where jack mackerel are naturally abundant (Squire 1972, 1983). The index based on general linear models was calculated with the model for northern anchovy described by Lo et al. (in press). Both indices indicate that abundance increased dramatically during the mid-1970s and that jack mackerel biomass can remain at low levels for relatively long periods of time (ten or more years).

It would probably be difficult to detect changes in jack mackerel using existing CalCOFI or fish-spotter indices. None of the indices appear precise because variability in each is larger than the variability in abundance that could probably be expected for jack mackerel, which is a long-lived fish and not expected to change dramatically in abundance from year to year (MacCall and Stauffer 1983; MacCall and Prager 1988). In addition, the three indices are not well correlated (Table 1.2.3-2).

Absolute magnitude of recruitment for jack mackerel cannot presently be determined, although an index of virtual year-class strength, obtained by summing the percentage contributions of a year class to the various seasons in which it was fished, provides a rough indication of year-class variability (Table 1.2.3-3). An average year class will, using this measure, have a relative strength of 100%. Long-term trends cannot be detected, since a year class is effectively compared only to year classes immediately preceding and following it (Mason 1991).

Virtual year-class strengths for 1947 to 1958 show a pattern in which strong year classes appear every five years (Table 1.2.3-3 and Figure 1.2.3-2). Recruitment was relatively low from 1959 to 1966. After 1966, strong year classes appeared every two to three years.

The age at which jack mackerel recruit to fisheries depends on the location of the fishery. Jack mackerel begin to recruit to the southern California purse seine fishery in their first year.

MSY for jack mackerel has not been estimated, but crude estimates of potential yield (Gulland 1970; MacCall and Stauffer 1983) have been developed. Potential yield of jack mackerel is not meant to be an estimate of sustainable harvest but, rather, an interim limit for catches while data sufficient for management are accumulated. Ages 0.5 through 8 are harvested by the inshore fishery off southern California and have a potential yield of about 100,000-200,000 MT. The potential yield of large fish in offshore and northern regions is about 10,000-25,000 MT. The potential yield of fish ages 9 to 15 years is about 20,000-50,000 MT. The total stock has a potential yield of 130,000-275,000 MT. As pointed out in PFMC (1990b), larger harvests might be sustained as the nearly virgin stock is fished down.

1.2.4 - Fishery Utilization

The southern California segment of the stock has been fished since the late 1940s, when jack mackerel served as a substitute for the failing sardine fishery. Landings data are given in Table

2.1.1-1. Purse seiners prefer Pacific mackerel because jack mackerel tend to occur further from port and over rocky bottoms where there is increased risk of damage to nets. Mason (1991) describes the history of management for the jack mackerel fishery off southern California.

Offshore, large adult jack mackerel are sometimes taken incidentally in trawls for Pacific whiting. During the 1970s, foreign trawl fisheries may have caught 1,000-2,000 MT annually, but catches by foreign and joint-venture fishermen in the 1980s ranged from nil to about 100 MT.

1.2.5 - Current Management

Jack mackerel was included in the Groundfish Fishery Management Plan (PFMC 1990c) because of foreign trawl fishery catches in the 1970s. Before 1991, an annual quota of 12,000 MT (north of 39° N latitude) was used to account for the incidental harvest while avoiding constraints on fishing for other groundfish species, particularly Pacific whiting. In 1991, in response to increased interest in fishing for jack mackerel, PFMC adopted a coastwide quota of 46,500 MT for jack mackerel.

Table 1.2.3-1. Indices of relative abundance for jack mackerel from CalCOFI and fish-spotter data

<u>Year</u>	<u>CalCOFI</u>	<u>CPUE</u>	<u>Lo-GLM</u>
1952	2.41		
1953	0.69		
1954	1.19		
1955	0.81		
1956	0.35		
1957	1.35		
1958	0.35		
1959	0.17		
1960	0.30		
1961	1.08		
1962	0.81		0.28
1963	0.73	0.64	1.21
1964	0.17	0.84	0.77
1965	0.79	0.30	0.77
1966	1.25	0.21	0.24
1967	1.70	0.22	0.80
1968	2.60	0.21	1.27
1969	1.57	0.19	0.30
1970		0.07	0.15
1971		0.09	0.66
1972	1.63	0.07	0.61
1973		0.05	0.02
1974		0.15	0.18
1975	0.35	0.19	0.69
1976		0.51	0.61
1977		1.13	4.80
1978	0.13	5.19	3.93
1979		2.01	1.06
1980		2.23	0.64
1981	0.08	2.93	0.41
1982		1.50	0.53
1983		1.51	0.12
1984		0.35	0.39
1985		0.70	0.33
1986		0.84	0.14
1987		0.58	0.09
1988		3.14	0.05
1989		2.66	0.15
1990		0.39	0.04

All data series were rescaled to a mean of 1.0 for years of overlap. The label "CalCOFI" is for estimates of relative abundance (number larvae per area) from a general linear model fit to CalCOFI larval data (MacCall and Prager 1988, data from Alec MacCall, NMFS, Southwest Fisheries Science Center, pers. comm.). The label "CPUE" is for a catch-per-unit-effort-like index from fish-spotter data (Jim Squire, NMFS, Southwest Fisheries Science Center, pers. comm.). The label "Lo-GLM" is for estimates from general linear models fit to fish-spotter data (N. C-H. Lo, NMFS, Southwest Fisheries Science Center, pers. comm.).

Table 1.2.3-2. Linear correlation coefficients for indices of jack mackerel abundance

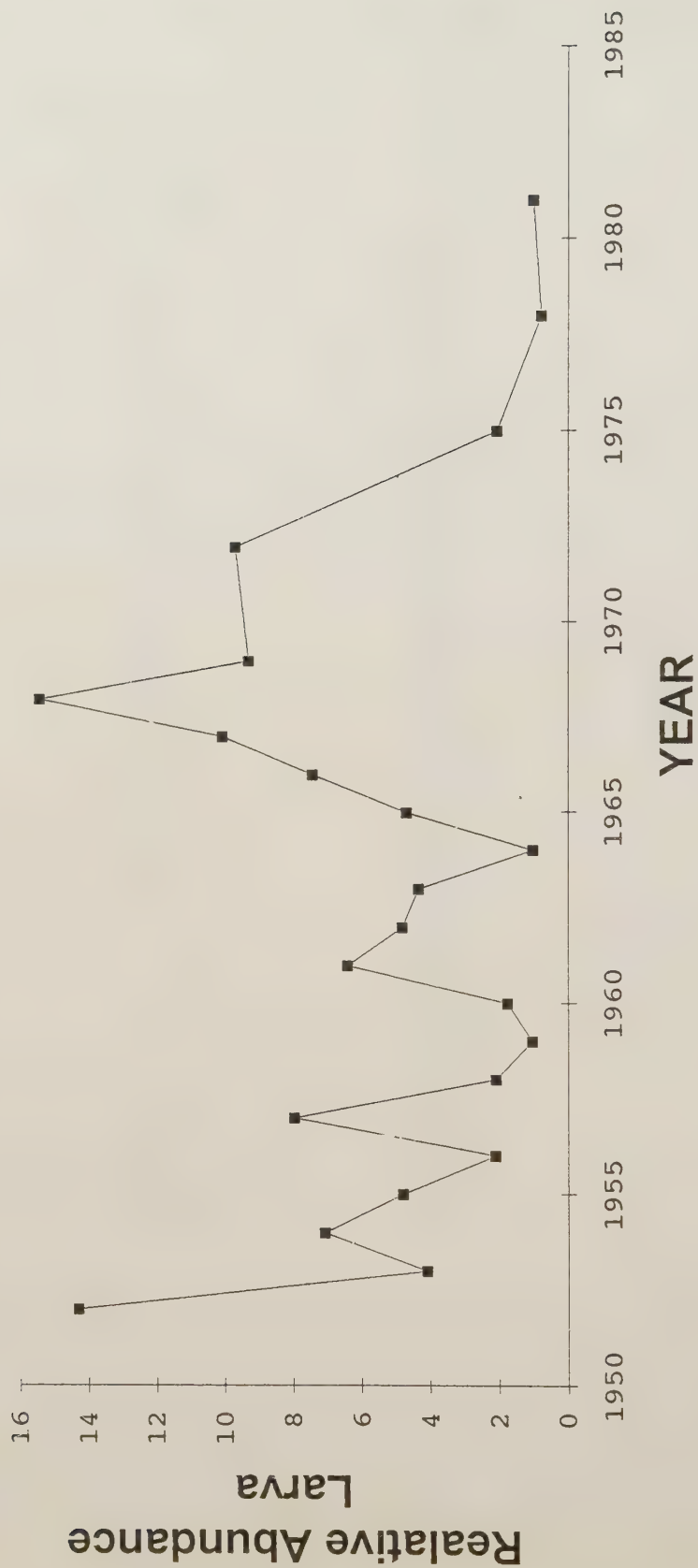
	MacCall and <u>Prager (1988)</u>	Lo et al. <u>pers. comm.</u>
Lo et al. pers. comm.	-0.57	
Squire pers. comm.	-0.24	0.38

Table 1.2.3-3. Virtual year-class strength estimates from jack mackerel catch-at-age data for 1959-1966

<u>Year</u>	<u>Year- Class Strength</u>
1947	1.629
1948	0.382
1949	0.392
1950	0.355
1951	0.646
1952	2.366
1953	1.312
1954	0.468
1955	0.403
1956	0.414
1957	0.860
1958	2.039
1959	1.215
1960	1.125
1961	0.661
1962	0.512
1963	0.536
1964	0.708
1965	0.678
1966	0.906
1967	1.591
1968	0.955
1969	1.163
1970	1.647
1971	0.771
1972	0.857
1973	0.564
1974	1.721
1975	0.402
1976	1.336
1977	0.419
1978	1.556
1979	0.495
1980	2.065

Source: J. Mason, NMFS, Southwest Fisheries Science Center, pers. comm.

Relative Abundance of Jack Mackerel Larva



Virtual Year-class Strength for Jack Mackerel

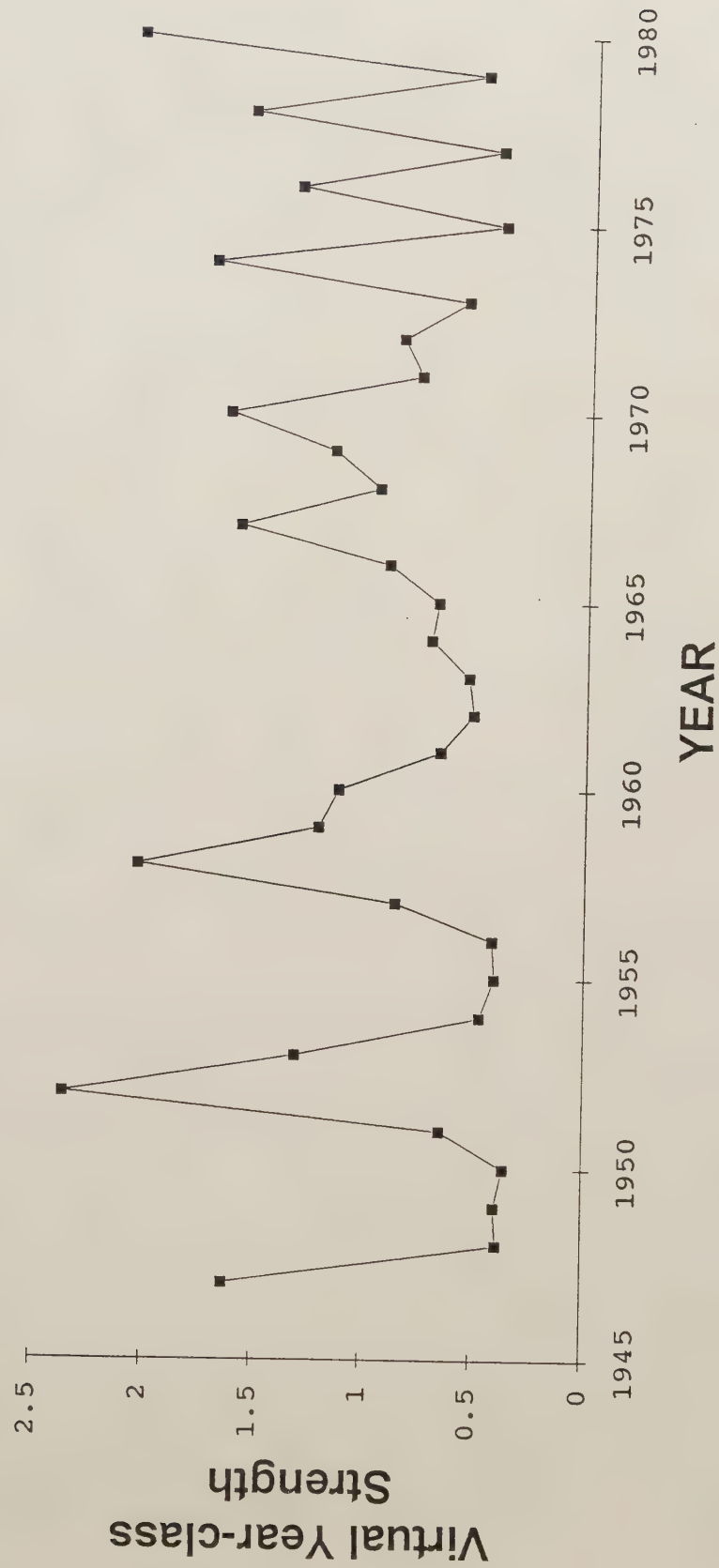


Figure 1.2.3-2. Virtual year-class strength for jack mackerel.

1.3 - Pacific Sardine

Extensive literature is available on this species. Detailed information about the biology of Pacific sardine is available in Frey 1971, Clark and Marr 1955, Ahlstrom 1960, Murphy 1966, MacCall 1979, and in the references cited in the following sections.

Common names include California pilchard, pilchard (in the northern part of its range), and sardina monterrey (in the southern part of its range).

1.3.1 - Distribution and Habitat

Sardines are relatively small, pelagic fish inhabiting coastal temperate waters (between about 7° and 28° C) and are commonly found in schools. Sardines (Sardinops) exhibit an extensive antitropical distribution in eastern boundary currents in the Atlantic and Pacific, and in western boundary currents of the Indo-Pacific. Although Sardinops sagax has been the species name commonly reserved for sardines occurring off the western coasts of North and South America, recent studies (Parrish et al. 1989) consider the genus Sardinops to be monotypic and Sardinops sagax to be the correct scientific name for sardine populations in the Alguhas, Benguela, California, Kuroshio and Peru currents, and for populations off New Zealand and Australia.

In the California Current system, sardines occur from southern Baja California to southeastern Alaska and in the Gulf of California. In the northern portion of the range, occurrence is seasonal. It has been generally accepted that the sardine population off the west coast of North America consists of three subpopulations. A northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation were distinguished on the basis of seriological techniques (Vrooman 1964). A fourth, far northern, subpopulation was also postulated (Radovich 1982). Although the ranges of the northern and southern subpopulations overlapped, the stocks apparently moved north and south at similar times and did not overlap. Recent electrophoresis and examination of morphological variation (Hedgecock et al. 1989) showed no genetic variation among sardines from central and southern California, the Pacific coast of Baja California or the Gulf of California.

Historically, the sardines migrated extensively, moving north as far as British Columbia in the summer and returning to southern California and northern Baja California in the fall. Tagging studies (Clark and Janssen 1945) indicated that the fish moved farther northward with increased age. The migration was complex, and timing and extent of movement were affected to some degree by oceanographic conditions (Hart 1973). At present, the population residing off the west coast of North America is relatively small, and is found off central and northern California and Baja California. Abandonment of spawning area and contraction of range have been associated with decreases in size of sardine populations around the world (Parrish et al. 1989).

1.3.2 - Life History

Pacific sardines reach about 41 cm, but usually are shorter than 30 cm. They live as long as 13 years, although most sardines in the historical and current commercial catch are 5 years and younger. There is a good deal of regional variation in growth rate, with average size at age increasing from south to north (Phillips 1948). Size and age at maturity may decline with a decrease in biomass, although latitudinal and temperature effects may also play a part (Butler 1987). At low biomass levels, sardines appear to be fully mature at age 2, whereas at high biomass levels only some of the 2-year-olds are mature (MacCall 1979). Natural mortality (M) for Pacific sardine has been estimated at 0.4 yr^{-1} (MacCall 1979) and 0.51 yr^{-1} (Clark and Marr 1955). A natural mortality rate of $M = 0.04 \text{ yr}^{-1}$ means that 33% of the sardine stock would die each year of natural causes if there were no fishery.

Pacific sardines spawn in loosely aggregated schools in the upper 50 m of the water column probably year-round, with peaks from April to August from Point Conception to Magdalena Bay, and from January to April in the Gulf of California (Allen et al. 1990). Historically, spawning may also have been fairly regular off central California. Spawning has been observed off Oregon, and young fish have been seen in waters off British Columbia, but these were probably sporadic occurrences (Ahlstrom 1960). The main spawning area for the historical population off the U.S. west coast was between Point Conception and San Diego, out to about 100 miles offshore, with evidence of spawning as far as 250 miles offshore (Hart 1973). Most spawning occurs between 13° and 17° C, with an apparent optimum between 15° and 16° , and a minimum temperature of 13° C (Ahlstrom 1960). The spatial and seasonal distribution of spawning is influenced by temperature. The center of sardine spawning has shifted northward and continued over a longer period of time during warm water conditions (Butler 1987; Ahlstrom 1960).

Pacific sardines are serial spawners and spawn several times over a season, though the number of spawnings is not well known. Both eggs and larvae are found near the surface. Sardine eggs are spheroid, have a large perivitelline space, and require about three days to hatch at 15° C.

Sardines prey on crustaceans, mostly copepods, and consume other phytoplankton and zooplankton, including fish larvae. Larval sardines feed extensively on the eggs, larvae and juvenile stages of copepods, as well as on other phytoplankton and zooplankton.

Pacific sardines are taken by a variety of predators throughout all life stages. Sardine eggs and larvae are consumed by an assortment of invertebrate and vertebrate planktivores. Although it has not been demonstrated in the field, anchovy predation on sardine eggs and larvae was postulated as a possible mechanism for increased larval sardine mortality from 1951 to 1967 (Butler 1987). Juvenile and adult sardines are consumed by a variety of predators, including commercially important fish (such

as yellowtail, barracuda, bonito, tunas, marlin, mackerel, hake and sharks), seabirds (pelicans, gulls and cormorants) and marine mammals (sea lions, seals, porpoises and whales). Although predators have not been well documented during recent periods of low sardine abundance, it is likely that sardines will, as they continue to increase, become more important as prey for numerous species, including endangered ones such as the California brown pelican (Pelecanus occidentalis californicus).

1.3.3 - Abundance, Recruitment and Population Dynamics

Estimates of the abundance of sardines from 1780 to 1970 have been derived from the deposition of fish scales in sediment cores from the Santa Barbara Basin off southern California (Soutar and Issacs 1969, 1974; Baumgartner et al. 1992). Significant sardine populations existed throughout the period, with biomass levels varying widely. Both sardine and anchovy populations tend to vary over periods of roughly 60 years, although sardines have varied more than anchovy. Sardine population declines were characterized as lasting an average of 36 years; recoveries lasted an average of 30 years.

Biomass estimates of the sardine population inferred from scale-deposition rates in the 19th and 20th centuries (Soutar and Isaacs 1969; Smith 1978) indicate that the biomass peaked in 1925 at 6,226,000 MT (Table 1.3.3-1). The spawning biomass estimated from virtual population analysis averaged 3,520,000 MT from 1932 to 1934, fluctuated from 2,844,000 to 1,206,000 over the next 10 years, then declined steeply from 1945 to 1965, with some short-term reversals following periods of particularly successful recruitment (Murphy 1966; MacCall 1979). During the 1960s and 1970s, biomass levels were thought to be as low as 5,000 MT. Signs of a recovery were evident in the 1980s (Wolf and Smith 1986; Wolf et al. 1987), and recent estimates (Barnes et al. 1992) indicate that the spawning biomass was 115,000 MT during 1990.

Recruitment of Pacific sardines is highly variable. Analyses of the sardine stock-recruitment relationship have been controversial, with some studies showing a density-dependent relationship (production of young sardines declines at low levels of spawning biomass) and others finding no relationship (Clark and Marr 1955; Murphy 1966; MacCall 1979). MacCall found the average potential growth rate of the historical population was 8.5%, with large fluctuations; even with no fishing mortality, the population on average was capable of replacement only. Recruitment occurs in strings, with several years of successful recruitment followed by similar periods of poor recruitment (Table 1.3.3-1).

Sardines age 3 and older were nearly fully recruited to the fishery until 1953, but age 2 and age 3 fish became less available as the population declined and southern fish migrated north (MacCall 1979). Analysis of recent catch data indicates that fish begin to recruit at age 1 and are fully vulnerable at age 3 (Barnes et al. 1992). Sardines probably become vulnerable to the live bait fishery, which is located close to shore, at an earlier age.

MSY for the historical Pacific sardine was estimated to be 250,000 MT annually (MacCall 1979; Clark 1939), which is far below the catch of sardines during the historical fishery. Extreme natural variability and susceptibility to overfishing are characteristic of clupeoid stocks (Cushing 1971).

1.3.4 - Fishery Utilization

The sardine fishery first developed in response to demand for food during World War I. Landings increased from 1916 to 1936, and peaked at over 700,000 MT. The Pacific sardine supported the largest fishery in the Western Hemisphere during the 1930s and 1940s, with landings in British Columbia, Washington, Oregon, California and Mexico. The fishery declined, beginning in the late 1940s and with some short-term reversals, to extremely low levels in the 1970s. There was a southward shift in the catch as the fishery decreased, with landings ceasing in the northwest in 1947-48, and in San Francisco in 1951-52. Sardines were primarily used for reduction to fish meal and oil and as canned food, with small quantities taken for live bait. An extremely lucrative dead bait market developed in central California in the 1960s.

Since the early 1980s, sardines have been taken incidentally with Pacific and jack mackerel in the southern California mackerel fishery and primarily canned for pet food, although some were canned for human consumption. Sardines landed in the directed sardine fisheries off southern and central California are primarily canned for human consumption and sold overseas, with minor amounts sold fresh for human consumption and animal food. Small quantities are harvested for dead bait and live bait. Sardines landed in Mexico are used primarily for reduction. Sardines landed in California are not now used for reduction. Sardine landings data are given in Table 2.1.1-1.

1.3.5 - Current Management

Pacific sardines are currently managed by the state of California. If the estimated spawning biomass is 18,140 MT a directed quota of 907 MT is allowed. This quota may be increased by the Department of Fish and Game when warranted, but only at a rate that will allow continued increase and rehabilitation of the population. A quota of 227 MT (454 MT when the directed quota is 2,268 MT or greater) is reserved for dead bait. The directed and dead bait quotas are subject to geographic allocations. A quota of 907 MT is reserved for live bait. When the spawning biomass is less than 18,140 MT, commercial fishing is prohibited. During a moratorium, or for the remainder of the calendar year after the directed quota is landed, the incidental catch is limited to 15%-35% by weight, depending on the occurrence of incidental sardines in the mackerel fishery (Fish and Game Code). Under current policy, total harvests are limited to 10% of the estimated spawning biomass, including an estimated Mexican catch. A rehabilitated resource is defined as a spawning biomass of 1 million tons, with

an age and size distribution and geographic range comparable to that of the historic population.

Table 1.3.3-1. Estimates of biomass (thousand MT of 2-year-old fish and older) and recruitment (thousands of 2-year-old fish in the year class indicated)^a

Year	Spawning Biomass			Recruits ^c	1910
	Scale Deposition ^b	VPA ^c	GLM ^d		
1,738					
1915	2,444				
1920	5,055				
1925	6,226				
1930	5,300				
1932		3,523		3,981	
1933		3,414		8,860	
1934		3,624		14,202	
1935		2,844		4,098	
1936		1,688		2,821	
1937		1,206		5,383	
1938		1,201		6,940	
1939		1,607		6,763	
1940		1,760		11,808	
1941		2,457		14,442	
1942		2,064		6,152	
1943		1,677		3,268	
1944		1,206		3,720	
1945		720		2,385	
1946		566		1,625	
1947		405		1,667	
1948		740		3,875	
1949		793		4,261	
1950		780		3,690	
1951		277	176	290	
1952		136	101	397	
1953		202	6	972	
1954		239	216	1,197	
1955		170	166	382	
1956		108	124	264	
1957		90	132	588	
1958		177	284	1,586	
1959		122	267	905	
1960		88	176	288	
1961		54	78	111	
1962		27	24	74	
1963		21	30	56	
1964		11		11	
1965		3			
1984			30		
1985			99		
1986			57		
1987			119		
1988			160		
1989			160		
1990			115		

^a For example, there were 3,532,000 MT of sardines in 1932, and the 1932 year class produced 3,981,000 age-2 recruits.

^b Estimates from scale-deposition rates converted to biomass (Smith 1978).

^c Virtual population analysis estimates of biomass and recruitment for 1932 to 1944 from Murphy (1966) and for 1945 to 1965 from MacCall (1979).

^d Estimates from a general linear model (Barnes et al. 1992).

1.4 - Pacific Mackerel

Pacific mackerel found off the Pacific coast of the United States are often called chub or blue mackerel and are probably the same species as mackerel of various names (Scomber spp.) found in the Atlantic and western Pacific oceans (Hart 1973). Detailed information about the biology of Pacific mackerel is available in Frey 1971 and in the references cited in the following sections.

1.4.1 - Distribution and Habitat

Pacific mackerel in the northeastern Pacific range from Banderas Bay, Mexico, to southeastern Alaska, including the Gulf of California (Hart 1973). They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception. Pacific mackerel usually occur within 20 miles of shore but have been taken as far offshore as 250 miles (Fitch 1969; Frey 1971; Allen et al. 1990; MBC 1987).

There are three spawning stocks along the Pacific coasts of the United States and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California (Collette and Navem 1983; Allen et al. 1990; MBC 1987). The northeastern stock is harvested by fishermen in the United States and managed under this FMP.

Pacific mackerel adults are found in water ranging from 10.0° to 22.2° C (MBC 1987), and larvae may be found in water around 14° C (Allen et al. 1990). Subadults and adults move north in summer and south in winter between Tillamook, Oregon, and Magdalena Bay, Baja California. Northerly movement in the summer peaks during El Niño events (MBC 1987; MacCall et al. 1985). There is an inshore-offshore migration off California, with increased inshore abundance from July to November and increased offshore abundance from March to May (Cannon 1967; MBC 1987). Adult Pacific mackerel are commonly found near shallow banks; juveniles are found off sandy beaches, around kelp beds, and in open bays. Adults are found from the surface to depths of 300 meters (Allen et al. 1990). Pacific mackerel often school with other pelagic species, including jack mackerel and Pacific sardine.

1.4.2 - Life History

The largest recorded Pacific mackerel was 63 cm long and weighed 2.8 kg, but Pacific mackerel taken by commercial fishing seldom exceed 40 cm or 1 kg (Hart 1973; Roedel 1938). The oldest recorded age for a Pacific mackerel was 11 years, but most caught commercially are less than 4 years old (Fitch 1951). Some Pacific mackerel mature as 1-year-olds, and all are sexually mature by age 4 (Prager and MacCall 1988). The annual rate of natural mortality (M) is thought to be about 0.5 yr⁻¹, which means that 39% of the stock would die each year of natural causes in the absence of fishing (Parrish and MacCall 1978).

Pacific mackerel larvae eat copepods and each other (Collette and Nauen 1983; MBC 1987). Juveniles and adults feed on small fishes, fish larvae, squid and pelagic crustaceans such as euphausiids (Clemens and Wilby 1961; Turner and Sexsmith 1967; Fitch 1969; Fitch and Lavenberg 1971; Frey 1971; Hart 1973; Collette and Nauen 1983).

Pacific mackerel in the northeastern Pacific stock spawn from Eureka, California, south to Cabo San Lucas in Baja California (Frey 1971; MBC 1987) between 3 and 320 km from shore. The fish seldom spawn north of Point Conception (Fritzsche 1978; MBC 1987). Spawning occurs primarily from late April to July (MacCall and Prager 1988). An individual fish may spawn more than once and release 100,000 to 400,000 eggs each time (Clemens and Wilby 1961; Hart 1973).

Pacific mackerel larvae are subject to predation from a number of invertebrate and vertebrate planktivores. Juveniles and adults are eaten by larger fishes, marine mammals and seabirds. Predators include porpoises, California sea lions (Zalophus californianus), brown pelican (Pelecanus occidentalis), striped marlin (Terapturus audax), black marlin (Makaira indca), sailfish (Istiophorus platypterus), bluefin tuna (Thunnus thynnus), white sea bass (Atractoscion nobilis), yellowtail (Seriola dorsalis), giant sea bass (Stereolepis gigas) and various sharks (MBC 1987).

1.4.3 - Abundance, Recruitment and Population Dynamics

Biomass of Pacific mackerel (Figure 1.4.3-1) declined from almost 400,000 MT in the early 1930s to less than 100,000 MT in the late 1940s and early 1950s (Parrish and MacCall 1978; MacCall et al. 1985). After a brief resurgence in the early 1960s, the biomass declined to around 10,000 MT (or lower) and remained low until strong year classes appeared in the late 1970s. Abundance increased dramatically after 1977 and probably exceeded 200,000 MT every year during the 1980s. Pacific mackerel biomass is thought to have been about 240,000 MT in 1989 (Wolf 1989) but, based on preliminary analysis, is thought to be declining at present. Unofficial and preliminary biomass estimates indicate that Pacific mackerel biomass during 1991 may be about 150,000 MT. Analyses of scale-deposition data for Pacific mackerel (Soutar and Issacs 1974) indicate that the prolonged period of high biomass levels during the late 1970s and 1980s was an unusual event that might be expected to occur, on average, about once every 60 years (MacCall et al. 1985).

Recruitment of Pacific mackerel is variable and loosely linked to spawning biomass. Reproductive success, measured as spawning biomass divided by number of recruits, is highly variable and somewhat cyclic (MacCall et al. 1985).

Pacific mackerel become available to the commercial fishery in their first year of life. They become fully available to the fishery at about 4 years of age.

MacCall et al. (1985) estimated that Pacific mackerel might sustain average yields of from 26,000 to 29,000 MT per year under

management systems similar to that currently used to manage the stock.

1.4.4 - Fishery Utilization

Pacific mackerel in the northeastern Pacific are harvested by commercial fisheries in California and Mexico; some recreational harvest also occurs. Pacific mackerel are sold as fresh fish, canned for human consumption and pet food, and reduced to fish meal and oil.

Pacific mackerel are often taken by anglers, though seldom as a target species (Allen et al. 1990). From 1980 to 1989, the recreational catch averaged 1,330 MT per year (Wolf 1989).

1.4.5 - Current Management

Pacific mackerel are currently managed by the state of California. If the estimated biomass is greater than 135,000 MT, then the commercial catch is not restricted by a quota. If the biomass is between 18,000 and 135,000 MT, then a quota equal to 30% of the biomass above 18,000 short tons is applied. If the biomass is below 18,000 MT, commercial fishing stops (CDFG Code 1991). The history of Pacific mackerel fishery and management is described in Klingbeil 1983.

Pacific Mackerel Biomass

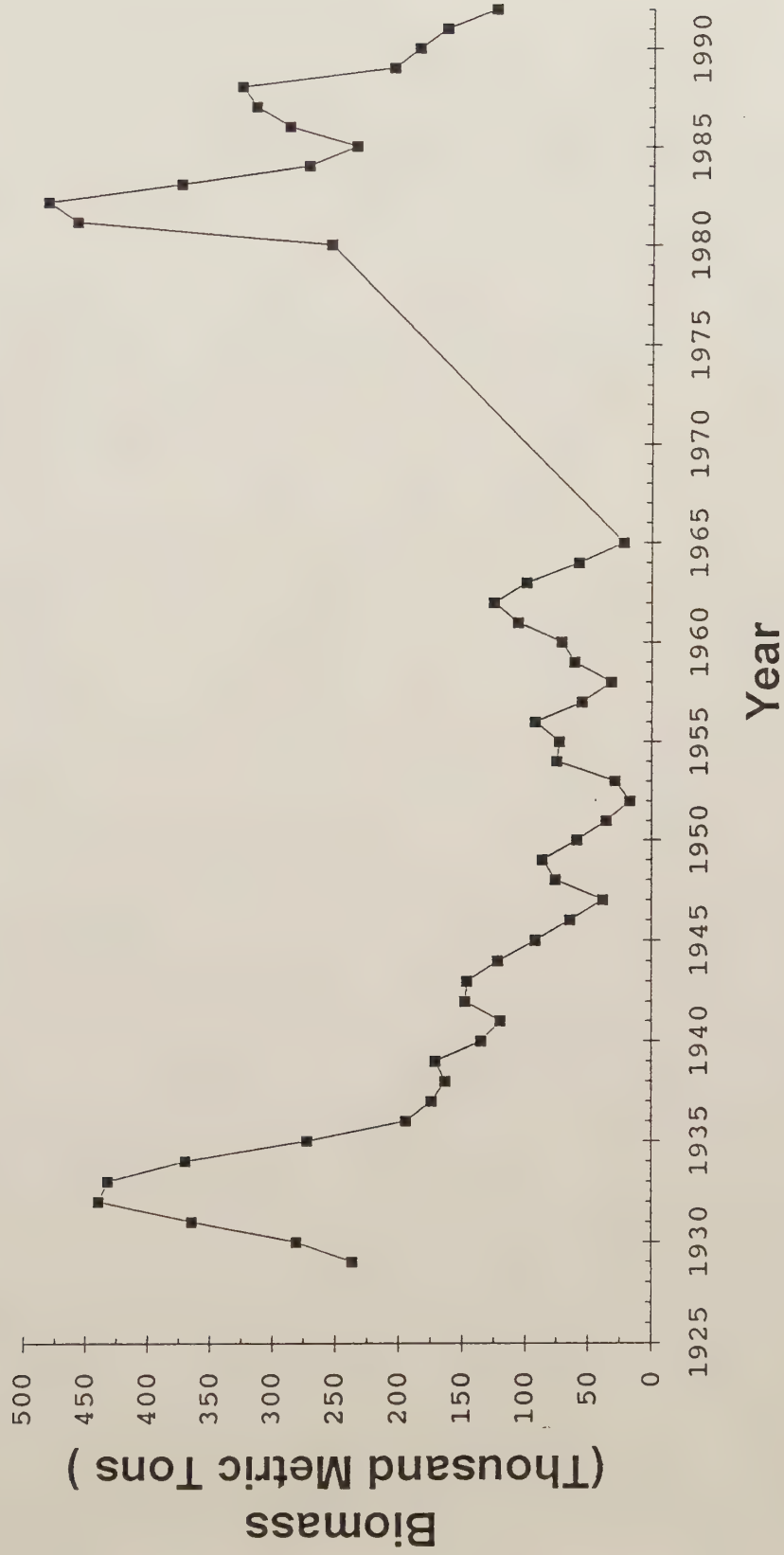


Figure 1.4.3-1. Pacific mackerel biomass estimates.

1.5 - California Current Ecosystem

The California Current is one of the world's four major eastern boundary currents characterized by coastal upwelling, high nutrient levels and high productivity. High nutrient levels in the California Current result from an influx of high-nutrient, subarctic water plus upwelling of nutrient-rich water within the system.

1.5.1 - Boundaries

The California Current ecosystem is an open system with no clearly defined boundaries and few sharp gradients. The coastlines of Canada, the United States and Mexico bound the ecosystem on the east, but the boundary is not distinct because anadromous and estuarine spawning fishes are significant components of the ecosystem and the region's fisheries. The northern boundary is best described by the northern limit of the West Wind Drift, near the northern end of Vancouver Island in British Columbia. The southern boundary is off southern Baja California where the California Current converges with equatorial waters. The offshore boundary of the California Current is usually given as the boundary region between the subarctic water and the eastern north Pacific central water at about 700 km offshore (435 miles; Sverdrup et al. 1942).

Pelagic fish species dominate the exploitable biomass of the California Current ecosystem, with major concentrations close to the coastline. The offshore boundary of the ecosystem for pelagic fishes is rather ephemeral and best described by the mean position of the summer wind stress maximum at about 200 km from the continental margin. In the southern California region, the offshore boundary is defined by the western coasts of the Channel Islands. Thus the California Current ecosystem is essentially a region of divergence and upwelling. The offshore area of convergence and downwelling is placed in the Oceanic Pacific ecosystem; the northern area of convergence and downwelling is placed in the Gulf of Alaska ecosystem.

The California Current ecosystem is characterized by a particularly narrow continental shelf and steep continental slope. This is especially true of the area from Cape Blanco, Oregon, to Point Conception, California, where, except in the coastal bight near San Francisco, the shelf is generally narrower than 25 km and the continental slope varies from about 20 km to 50 km. Off the Pacific Northwest, the topography is less steep, and the shelf and slope widths often exceed 50 and 70 km. The area off southern California is a classic "continental borderland" of alternating ridges and troughs, with ridges forming islands surrounded by submerged shelves. These large-scale features are punctuated throughout the region by other dramatic features such as deep submarine canyons, steep seamounts and innumerable banks, basins, troughs and rock piles of a wide range of sizes.

1.5.2 - Physical Oceanography

The eastern limb of the North Pacific Subtropical Gyre, off the western United States and northern Mexico, forms the California Current. In common with other equatorward eastern boundary currents, the California Current is characterized by a generally sluggish flow with filaments, mesoscale eddies, and counterflows. The large-scale surface flow originates in the subarctic waters at the northern boundary, and subarctic characteristics (temperature and nutrient levels) persist in the northern portions of the system. Underlying the surface flow is a poleward undercurrent, and often during periods of reduced upwelling, an inshore countercurrent. Upwelling of deeper subarctic water along the continental margin helps maintain a general subarctic character in the surface layers of much of the system. The southern, tropical margin of the system has a net equatorward outflow, but a nearshore, poleward flow of subtropical water along Baja California results in a strong subtropical influence in the nearshore region south of Point Conception, California.

The ecosystem is heavily influenced by wind-induced coastal upwelling, with the most intense upwelling centered near Cape Mendocino in northern California during the spring and summer. The cool core of upwelled water near the coast is most pronounced in summer, when it occurs from near Cape Blanco along the northern and central California coasts and extends in a plumelike structure to the southwest of Point Conception. A secondary upwelling zone occurs off Baja California, with a springtime, local maximum near Punta Baja.

The Mexican and southern California sections of the California Current are characterized by nearly continuous, low-intensity upwelling that is interrupted only by brief, though often intense, atmospheric disturbances. From Point Conception to Cape Blanco, the region of maximum upwelling, upwelling is intense in spring and early summer; in winter, storms cause alternating periods of onshore and offshore transport. In winter, the typical wind systems cause a predominance of upwelling in the Point Conception area. This upwelling weakens to the north and progressively changes into a predominance of downwelling in the region north of Cape Blanco. Upwelling occurs during the summer in the region between Cape Blanco and Vancouver Island; however, the seasonal latitudinal shifts of the Pacific Basin's atmospheric pressure systems and intense winter storms result in a net annual onshore transport in this region. Offshore transport occurs only intermittently to the north of Vancouver Island.

The combined effects of the southerly surface currents and coastal upwelling result in cool sea-surface temperatures over most of the northern part of the California Current. Winter sea-surface temperatures off Vancouver Island average 8° C and increase southwards to 22° C in southern Baja California. Summer sea-surface temperatures in the region of maximum upwelling, from Cape Blanco to Point Conception, are particularly cool. July sea-surface temperatures in the nearshore areas of northern California

average less than 12° C, which is slightly colder than the July sea-surface temperatures in the northernmost Gulf of Alaska. Mean summer sea-surface temperatures are above 14° C in the region between Cape Blanco and Vancouver Island.

Seasonal and interannual environmental variability within the California Current ecosystem are associated with variations in the Pacific Basin atmospheric pressure systems, which control the local winds and Ekman transport and affect flows of the equatorward California Current, the poleward undercurrent and the inshore countercurrent. Variations on time scales of several years are associated with alterations in the tropical pressure system, i.e., the El Niño/Southern Oscillation phenomenon. El Niño events markedly increase temperature and alter the flow of currents in the California Current.

1.5.3 - Biology and Ecology

The California Current comprises four relatively distinct, though related, ecological components: the pelagic, the littoral, the demersal, and the anadromous. The component of most concern to the present fisheries management plan is the pelagic, which encompasses the offshore surface water layer and the species therein, including coastal pelagic fish (northern anchovy, Pacific sardine, Pacific herring, jack mackerel, Pacific mackerel, bonito, and saury), squids, seabirds, pinnipeds (sea lions and fur seals) and cetaceans (porpoises and whales). Most of the forage produced in the California Current ecosystem (i.e., phytoplankton and zooplankton) comes from the pelagic component.

The exploitable biomass of fishes in the ecosystem is dominated by the pelagic component. As in the other major eastern boundary currents, anchovy, sardine, whiting, jack mackerel, and Pacific mackerel achieve the largest populations. These populations are extremely important to the trophic dynamics of the entire California Current ecosystem; anchovy and sardines are the only fishes in the ecosystem that consume large quantities of primary production (phytoplankton), and all five of the species are significant consumers of zooplankton. All five species, particularly mackerels and whiting, are important predators of the early stages of other fishes. The juvenile stages of all five species, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans and other fishes.

Trophic interactions between CPS and higher-trophic-level fishes are poorly understood, and it is unknown if populations of individual predaceous fishes are enhanced or hindered by large populations of CPS. It is not known if the value of CPS as forage to adult predators outweighs the negative effects of predation by CPS on predator's larvae and juveniles plus competitive removal of phytoplankton, zooplankton and other fishes.

1.5.4 - Climate and Distribution of Species

Fishes that dominate the pelagic component of the California Current ecosystem are all warm-temperate or subtropical species that have their centers of reproduction in the southern portion of the system. These fishes are unable to complete the early stages of their development at temperatures much below 13° C, with the exception of Pacific whiting, whose minimum is about 10° C. Much of the region north of Point Conception is seasonally outside the range of acceptable temperatures for early stages of CPS species. The region of maximum upwelling (Cape Blanco, Oregon, to Point Conception, California) is particularly unfavorable to early stages of CPS because the summer winds and upwelling peak cause low temperatures and extensive offshore transport (Parrish et al. 1981). Although the region is relatively unfavorable for reproduction of the major pelagic fishes, adults and subadults use the region extensively for feeding. Sardine and whiting, in particular, migrate across the region to feed in the northern section of the current system and to spawn in the Southern California Bight.

In comparison with the region of maximum upwelling, the Pacific Northwest region (Vancouver Island to Cape Blanco) is more favorable for the reproduction of coastal pelagic fishes because coastal upwelling is weaker and of shorter duration; the period of favorable temperatures is longer; summer temperatures are warmer; and the Columbia River Plume provides nutrients that contribute to a favorable spawning environment. Separate stocks of Pacific whiting (Bailey et al. 1982) and anchovy (Parrish et al. 1981) occur in the region and, before its population collapse, sardine commonly spawned in the region (Walford and Mosher 1941). The present biomass of CPS stocks in the Pacific Northwest is, however, considerably smaller than the biomass of CPS stocks that spawn off of southern California and northern Baja California.

This distribution and abundance of CPS could change with relatively minor climatic change. Colder sea-surface temperatures of only one or two degrees during the spring and summer could greatly reduce the biomass of the resident whiting or anchovy stocks in the Pacific Northwest by lowering temperatures below the tolerance limits of the early life-history stages or by shifting the stocks southward. Conversely, warmer spring and summer temperatures could make the region a prime spawning habitat for the entire pelagic complex. There is some evidence that pelagic fishes were much more abundant in the northern portion of the California Current ecosystem during warm periods. Anchovies were very abundant in Puget Sound during the warm 1890s (Swan 1893). Pacific and jack mackerels were very abundant in the region during the 1982-83 El Niño (Pearcy et al. 1985). Sardines were very abundant in Puget Sound during the warming of the 1930s (Lluch-Belda et al. 1989).

The southernmost region in the California Current ecosystem, off southern Baja California, contains stocks of CPS that are

somewhat independent of those farther north. These southern stocks, which occur at the warm end of temperature tolerance limits, are characterized by a young age at maturity, high mortality rates and much lower growth rates than the dominant stocks that spawn off northern Baja California and southern California.

1.5.5 - Perspective on Instability of Pelagic Fish Populations and Fisheries

From a fisheries perspective, the most significant characteristic that CPS have in common is their propensity for rapid change (Lluch-Belda et al. 1989). Population size of individual stocks, biomass of some key species, and fishery yields have changed greatly since the inception of major fisheries on CPS in the 1930s. Populations of sardines and Pacific mackerel have been particularly variable, with biomass levels declining to considerably less than one percent of maximum levels.

There is evidence that CPS abundance varied considerably before the inception of modern fisheries (Soutar and Issacs 1969, 1974) and such variation is expected to depend heavily on environmental conditions. Fishing has, however, probably exacerbated the natural variability in recent decades because reduced stock size and loss of old fish, the inescapable results of fishing, increase the speed and magnitude of population decreases during periods of poor reproduction. In addition, the probability of stock collapse is exacerbated because fish in a highly exploited stock may not live long enough to successfully reproduce. Fishery management approaches based on equilibrium or steady-state concepts that ignore variability in abundance have a long history of failure for CPS in many regions of the world (Troadec et al. 1980).

A second feature that will severely affect fishery yields is the geographical expansion and contraction of range associated with changes in the size of CPS populations (MacCall 1990). Geographic range typically expands when abundance increases and contracts when abundance decreases; thus a species may become unavailable at the edge of its range during a period of low abundance. In contrast, density at the center of the distribution tends to remain rather constant, so catch rates do not decline as fast as abundance. This characteristic has been an important part of the decline of several CPS fisheries, including the fishery for Pacific sardine.

It should be realized that no management regime will produce stable yields for individual CPS species. Biomass of any species managed under this plan may decline to low levels for extended periods, and periods of low biomass will probably occur more frequently, for longer periods of time and be more intense under exploitation. Consequently, managers of CPS should expect considerable interannual variation in abundance and yields and plan to curtail fisheries during periods of low abundance to protect the reproductive capacity and long-term health of the CPS stocks.

1.6 - Marine Mammal Predators

CPS are eaten by a number of marine mammals (Table 1.6-1), although their importance as forage varies from predator to predator. A great deal of information is available about the diets of marine mammals, and the total amount of CPS eaten per year has been estimated for a few. It is not currently possible, however, to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem, or the size of CPS populations necessary to sustain predator populations.

1.6.1 - Management of Marine Mammals

Marine mammal management is based on the Marine Mammal Protection Act of (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973. Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (the number of animals at which productivity is maximum, usually regarded as 60% of carrying capacity or maximum population size) can be listed as depleted. Under the ESA, species in danger of extinction throughout all or a significant portion of their range can be listed as endangered, and species likely to become endangered in the foreseeable future can be listed as threatened. Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Fisheries that interact with species listed as depleted, endangered or threatened may be significantly affected under the terms of the ESA and MMPA.

1.6.2 - Northern Fur Seal

The California Current ecosystem is an important feeding and breeding ground for northern fur seals (Callorhinus ursinus). The total population of northern fur seals in 1983 was estimated to be 1.2 million (Fowler, in press). A small population of 5,000 to 7,000 breeds on San Miguel Island in the Channel Islands; the remainder breed in Alaska and Asia. Northern fur seals are found offshore, most densely along and just beyond the continental shelf from Washington through southern California. Northern fur seals that breed on San Miguel Island forage offshore over the continental shelf between San Miguel Island and Point Conception (Antonelis et al. 1980). Between December and May of each year, the resident population in California is joined by approximately 400,000 adult females from the breeding population at the Pribilof Islands in the Bering Sea.

The abundance of northern fur seals is approximately 50% as high as in the 1950s and 1960s, and northern fur seals are classified as a depleted species under the MMPA. The most useful index of population size is the number of pups born at various rookeries. On St. Paul Island in the Bering Sea, where most of the Pribilof population breeds, pup numbers declined from about 451,000 animals in 1950 to 182,000 in 1985 (Fowler, in press). Reasons suggested for the decline include harvest of adult females between

1956 and 1968 and increased natural mortality at sea beginning in the mid 1960s. Other possible causes under investigation include entanglement in man-made debris, incidental take in drift gill net fisheries and possible competition with commercial fisheries for prey fish.

Feeding habits of northern fur seals are well known (Mead 1953; Kajimura 1984; Antonelis and Perez 1984; Loughlin and Livingston 1986; Sinclair 1988). Fur seals prey on pelagic schooling fishes, squids and, to a lesser extent, demersal fish. Fur seals probably preyed extensively on sardines when they were abundant along the Pacific coast.

Fur seals prey on CPS covered by this management plan, most heavily on anchovy, followed by jack mackerel and Pacific mackerel. Anchovy was the most important prey (43% of the diet) for fur seals in California waters during 1984 (Antonelis and Perez 1984). About 21,000 MT of anchovy were consumed off California between January and June, with peak consumption from January through March. Off Oregon and Washington, anchovy was the third prey species in order of importance (11% of the diet) after herring and rockfish. About 4,000 MT of anchovy were consumed between January and June, with peak consumption during February through April. Northern fur seals are estimated to eat about 700 MT of jack mackerel per year (1% of the diet) off California. Northern fur seals in Oregon and Washington did not eat jack mackerel.

1.6.3 - California Sea Lion

California sea lions (Zalophus californianus) are found in coastal waters of the Pacific Ocean from southern Mexico to southern Canada. California sea lions breed on islands off southern California and Baja California, as well as in the Gulf of California. The U.S. population is growing at 11% a year and currently numbers about 100,000 to 114,000; the population off western Baja California is stable at 68,000 to 78,000 (Lowry, in prep.). Severe reductions in abundance of California sea lions occurred during the 19th and early 20th centuries. In 1928, Bonnot (1928) counted 1,429 in California. California sea lions are not listed as depleted, threatened or endangered.

During the summer breeding season, virtually all adults are present near rookeries. Males migrate northward in the fall, with the oldest going as far as British Columbia, then back to their rookeries in the spring. Adult females generally do not migrate away from rookery areas. Juveniles remain near rookery areas or move into waters off central California.

Diet studies indicate that California sea lions off southern California eat northern anchovy, jack mackerel, Pacific mackerel, sardine, other species of fish and cephalopods (Antonelis et al. 1984; Lowry et al. 1990, 1991). Northern anchovy is eaten more frequently than any other prey. Jack mackerel and Pacific mackerel are also common prey. At this time, sardine is not eaten in significant quantities, but its occurrence in the diet of California sea lions increased after 1987 as sardine biomass

increased (Lowry et al. 1991; Mark Lowry, Southwest Fishery Science Center, National Marine Fisheries Service, unpublished data). The sea lions' diet in southern and central California varies seasonally and yearly depending on abundance and availability of prey (Ainley et al. 1982; Antonelis et al. 1984; Lowry et al. 1990, 1991). No estimates of consumption of individual prey species are available, but the U.S. sea lion population probably consumes a total of 115,000 to 415,000 MT of forage per year (Lowry, in prep.).

1.6.4 - Northern (Steller's) Sea Lion

The northern, or Steller's, sea lion (Eumetopias jubatus) inhabits coastal waters from central California to the Aleutian Islands in the Bering Sea off Alaska and across the north Pacific to the Kuril Islands in the Okhotsk Sea off Japan. The center of the northern sea lion's distribution is the Gulf of Alaska and Aleutian Islands. Off California, northern sea lions breed at Año Nuevo Island, the Farallon Islands, Sugarloaf Island (Cape Mendocino) and St. George Reef (near Crescent City). Off Oregon, northern sea lions breed at Rogue Reef and Orford Reef. Northern sea lions do not breed in Washington waters, although a few hundred animals haul out along the coast year-round. Male sea lions, along with some adult females and juveniles, disperse away from rookeries after the summer breeding season; adult females with pups remain near the rookeries year-round.

Northern sea lions are listed as depleted under the MMPA and as threatened under the ESA. The population has declined over the last 30 years throughout its range, with major reductions from the Gulf of Alaska to the Kuril Islands (Merrick et al. 1987; Loughlin and Merrick 1989). Numbers of juveniles and adults in the Kuril Islands declined 74% between 1969 and 1989. Off Alaska, the number of juveniles and adults declined 80% between the late 1950s and 1990, and as much as 91% in some areas (Merrick et al. 1987, 1991; Loughlin et al. 1990). Numbers of northern sea lions at rookeries off Oregon are stable; in California they have declined, especially in the southern part of the range. Northern sea lions no longer use San Miguel Island as a rookery; none have been observed there since 1983. Año Nuevo Island, off the central California coast, is now the southernmost rookery.

Declines in abundance of northern sea lion may be due to natural factors or human activities. Insufficient data are available to evaluate the importance of environmental factors. It is likely, however, that declines were at least partly due to commercial harvests, sea lion control programs, fisheries, and subsistence hunting. Development and expansion of commercial fisheries throughout the animals' range may have reduced or altered food supplies.

Northern sea lions in central California mostly eat Pacific whiting, rockfish, flatfish, cusk-eels, and cephalopods, as well as small quantities of anchovy and jack mackerel, and probably sardines when available.

1.6.5 - Harbor Seal

Harbor seals (Phoca vitulina) are distributed along the coast and offshore islands from the northern region of western Baja California, Mexico, to Alaska. The population in 1986 was estimated to be at least 25,000 animals off California, and 11,000 off Oregon and Washington (Boveng 1988). Harbor seal populations are increasing in Washington and Oregon. Huber (1992) estimated that there were about 30,000 harbor seals in Washington waters during 1991 and about 7,000 in Oregon. Current abundance relative to historical levels is unknown. Harbor seals are not listed as depleted, threatened or endangered.

Off southern California, harbor seals eat rockfish, cusk-eels, plainfin midshipman, shiner surfperch, octopus, and flatfish. Infrequently they eat jack mackerel, other fish, and squid (Stewart and Yochem 1985). Anchovies in estuaries along the coast of Oregon and Washington are one of the most important prey for harbor seals throughout the year; many other species of schooling and demersal fish are also eaten (Tracey 1985).

1.6.6 - Guadalupe Fur Seal

Guadalupe fur seals (Arctocephalus townsendi) breed only on Guadalupe Island, Mexico. They are occasionally found at San Miguel Island, San Nicolas Island, and San Clemente Island off California and have been seen near San Francisco. During the last census, conducted during the breeding season in 1984, 1,600 fur seals were counted (Seagars 1984).

Historically, Guadalupe fur seals were very abundant, but the population was reduced to a few animals by commercial sealers in the 19th century. Currently, the population at Guadalupe Island is increasing, and the animals are not listed as depleted, threatened or endangered.

No data are available on the diet of Guadalupe fur seals, but it is assumed that they (like northern fur seals and California sea lions) eat anchovy, Pacific whiting, jack mackerel, Pacific mackerel, other small schooling fishes, and squid.

1.6.7 - Northern Elephant Seal

Northern elephant seals (Mirounga angustirostris) breed on islands off central Baja California, Mexico, north to the Farallon Islands off California and on isolated and protected beaches of central California. Major rookeries in the United States are located at San Miguel Island and San Nicolas Island off southern California.

The population is growing at an annual rate of 8.4%. There are an estimated 35,000 elephant seals in Mexico, 74,000 in the United States and 109,000 in total (Barlow, in prep.). The population was nearly extinguished in the 19th century by commercial sealers. The current population is descended from about 50 individuals that bred on Guadalupe Island (Le Boeuf and Bonnell 1980). Northern elephant

seals are not listed as depleted, threatened or endangered.

Adult males forage in the Gulf of Alaska and eastern Aleutian Islands. Adult females forage off Oregon and Washington as far as 1,900 km offshore (Stewart and DeLong 1991). Northern elephant seals feed on a variety of prey including squids, fish, crustaceans and tunicates in several oceanic habitat zones (Antonelis et al. 1987). Stomach contents of stranded juveniles in the Southern California Bight contained small quantities of anchovy (Hacker 1986).

1.6.8 - Bottlenose Dolphin

Two forms of bottlenose dolphins (Tursiops truncatus) exist: a coastal form and an offshore form. The coastal form ranges as far north as Monterey Bay (Wells et al. 1990); the offshore form's range is unknown. The population of the coastal form from La Jolla to San Pedro, California, was estimated at 173,000 to 240,000 (Hansen 1990). The offshore form in California waters during 1991 was estimated (preliminary figures) to number 2,400 in summer and fall and 3,800 in winter and spring (Barlow, in prep.; Forney, in prep.). Bottlenose dolphins in California are not listed as depleted, threatened or endangered.

The primary prey of coastal bottlenose dolphins in California are fishes and invertebrates inhabiting the littoral and sublittoral zones. Croakers and surfperch make up the bulk of the diet, and jack mackerel is a minor component (Walker 1981). The offshore form in California was observed feeding on anchovies near San Clemente Island (Leatherwood 1975).

1.6.9 - Pacific White-Sided Dolphin

Pacific white-sided dolphins (Lagenorhynchus obliquidens) are found on continental slope and offshore zones of the northeastern Pacific and Gulf of Alaska from about 20° N to 61° N latitude (Leatherwood and Walker 1982). Resident populations in the Southern California Bight and western Baja California, Mexico, are augmented by an influx of animals from outside the area from October through February; in summer these migrants disperse west and north. The resident population off California during 1991 (preliminary figures) was estimated at 11,000 in summer and fall and 44,000 in winter and spring (Barlow, in prep.; Forney, in prep.). Pacific white-sided dolphins in California are not listed as depleted, threatened or endangered.

Pacific white-sided dolphins primarily eat small schooling fishes and cephalopods from the epipelagic and mesopelagic zones. Northern anchovy appear to be important, but jack mackerel, Pacific mackerel, and sardines are also eaten (Walker et al. 1984).

1.6.10 - Common Dolphin

Common dolphins (Delphinus delphis) are found from 36° N latitude to south of the equator and offshore to 132° W (Leatherwood et al. 1982). Common dolphins are the most abundant cetacean in waters off California. Two forms of this species occur in California waters: the short-beaked form and the long-beaked form (Heyning and Perrin 1991). The long-beaked form inhabits coastal waters shallower than 100 fathoms and is usually found within 100 nautical miles of shore. The short-beaked form can be found from the coastline to thousands of miles offshore. Combined abundance of common dolphin off California during 1991 (preliminary figures) was estimated at 265,000 individuals during winter and spring and 450,000 during summer and fall (Barlow, in prep.; Forney, in prep.). Common dolphins in California are not listed as threatened or endangered.

Common dolphins off southern California eat northern anchovy in the fall and winter and deep-sea fishes in spring and summer (Leatherwood et al. 1982).

1.6.11 - Harbor Porpoise

Harbor porpoise (Phocoena phocoena) are distributed from Point Conception, California, to Alaska (Leatherwood et al. 1982). Most are found in water no deeper than 18 m (10 fathoms) although individuals have been observed in water as deep as 183 m (100 fathoms). Harbor porpoise off California, Oregon, and Washington in 1985 were estimated to number 45,713 (Barlow 1988). Harbor porpoise in California are not listed as depleted, threatened or endangered.

In general, harbor porpoise prey on a variety of cephalopods and fishes, especially schooling fishes such as anchovy, shad, herring, mackerel, sardines, pollock, and whiting (Leatherwood et al. 1982; Jones 1981). Off California they eat mostly fish such as juvenile rockfish, anchovy, Pacific whiting, and Pacific tomcod (Jones 1981). Off Washington, harbor porpoise prey on Pacific herring, smelt, and market squid (Gearin and Johnson 1991).

1.6.12 - Dall's Porpoise

Dall's porpoise (Phocoenoides dalli) are distributed from California to Alaska. Off California, Dall's porpoise are found along the coast as far south as the Channel Islands and in water deeper than 100 fathoms (Leatherwood et al. 1982). From late October to late May, individuals move south and inshore along the coasts of California and Baja California to Cedros and Guadalupe islands. The southward movement past Point Conception is greatest in cold-water years. Abundance of Dall's porpoise off California in spring 1991 (preliminary figures) was estimated as 4,800 during winter and spring and 27,000 during summer and fall (Barlow, in prep.; Forney, in prep.). Dall's porpoise in California are not

listed as depleted, threatened or endangered.

Dall's porpoise feed on squid, crustaceans, and such fish as anchovy, myctophids, saury, whiting, herring, jack mackerel, and Pacific mackerel (Norris and Prescott 1961; Stroud et al. 1981; Leatherwood et al. 1982). In southern California, they eat anchovy, saury, whiting, and squid (Stroud et al. 1981).

1.6.13 - Fin Whale

In winter, fin whales (Balaenoptera physalus) are distributed from central California to Cabo San Lucas, Baja California, outside the Channel Islands and farther offshore (Leatherwood et al. 1982). In summer, they range from central Baja California to the Bering Sea. The entire north Pacific population is estimated at about 16,000 (Leatherwood et al. 1982). Fin whales off California during the summer and fall of 1991 (preliminary figure) were estimated to number 800 (Barlow, in prep.). The fin whale was once very abundant, but commercial whaling reduced the population to very low numbers, and the fin whale is now listed as an endangered species.

Fin whales are known to feed on anchovy, krill, herring, pollock, capelin, lanternfish, and squid (Rice 1977; Leatherwood et al. 1982).

1.6.14 - Humpback Whale

During the summer, humpback whales (Megaptera novaeangliae) are found over the continental slope from Point Conception to Alaska and Japan. Three stocks, defined by wintering grounds, are recognized: (1) Asian, (2) Hawaiian, and (3) Mexican. The Mexican stock winters in southern Baja California, off the mainland near Manzanillo, off Islas Tres Marias, in the Gulf of California, and off the Revillagigedo Islands (Urban and Aguayo 1987). Humpback whales off California during 1991 (preliminary figures) were estimated to number 400 during winter and spring and 700 during summer and fall (Barlow, in prep.; Forney, in prep.). Another estimate for 1991, by photo-identification techniques, was 500 to 1,000 individuals (J. Calambokitis, Cascadia Research Collective, Olympia, WA, pers. comm.).

There were about 15,000 humpback whales in the north Pacific before 1905 (Leatherwood et al. 1982). Commercial whaling reduced the population to very low numbers, and the humpback whale is now listed as an endangered species.

Humpback whales are known to feed on anchovy, herring, juvenile rockfish, and euphausiids (Brownell 1964; Rice 1977; Dohl et al. 1983; Kieckhefer 1991). Anchovy is common in the diet of humpback whales in California (Rice 1977).

1.6.15 - Sei Whale

Sei whales (Balaenoptera borealis) are a pelagic temperate-water species. In winter, they are sparsely distributed from central California to the Revillagigedo Islands, Mexico. In

summer, they are found west of the Channel Islands, California, to the Gulf of Alaska (Leatherwood et al. 1982). Sei whales are present off central California in considerable numbers in late summer and early fall.

When sei whales were first heavily exploited by commercial whalers in 1963, there were an estimated 42,000 in the north pacific (Tillman 1977). This number was reduced to 8,600 by 1974 (20% of the original pre-exploitation estimate). The sei whale is listed as an endangered species.

Sei whales feed on anchovy, sardine, rockfish, sauries, jack mackerel, and krill (Brownell 1964; Rice 1977; Leatherwood et al. 1982). From June through August the dominant food of sei whales off California is anchovy; in September and October, their main food is krill (Rice 1977). Sardine and jack mackerel are a minor component in their diet.

1.6.16 - Minke Whale

Minke whales (Balaenoptera acutorostrata) are sparsely distributed from the Bering and Chukchi seas to the equator (Leatherwood et al. 1982). During 1991 Minke whales (preliminary figures), were estimated to number 100 in winter and spring and 200 in summer and fall (Barlow, in prep.; Forney, in prep.). Minke whales in California are not listed as threatened or endangered.

Minke whales prey on krill, copepods, and schooling fishes such as herring, anchovy, and sand lances (Leatherwood et al. 1982; Dorsey et al. 1990).

Table 1.6-1. References describing diets of marine mammals that eat northern anchovy, Pacific sardines, Pacific mackerel and jack mackerel

Marine Mammal	Anchovy	Sardine	Pacific Mackerel	Jack Mackerel
CETACEANS (whales, dolphins and porpoise):				
<u>Tursiops truncatus</u>	20			18
<u>Lagenorhynchus obliquidens</u>	8,9,10,11	8	1,6,7,8	6,7,8,9
<u>Delphinus delphis</u>	4,10,19	4		
<u>Phocoena phocoena</u>	9	19		
<u>Phocoenoides dalli</u>			4,6	19
<u>Megaptera novaeangliae</u>	1,5,17,22			
<u>Balaenoptera acutorostrata</u>	19			
<u>Balaenoptera borealis</u>	5,17,19	5		19
<u>Balaenoptera physalus</u>	5			
PINNIPEDS (seals and sea lions):				
<u>Callorhinus ursinus</u>	3,6,7,9		3	
<u>Arctocephalus townsendi</u>	3		3	
<u>Zalophus californianus</u>	2,3,9,13,14	14	2,3,13,14	2,3,9,13,14
<u>Eumetopias jubata</u>	9			9,21
<u>Mirounga angustirostris</u>	3,23	3		
<u>Phoca vitulina</u>	15			16

References:

- 1) Dohl et al. 1983
- 2) Antonelis et al. 1984
- 3) Antonelis and Fiscus 1980
- 4) Norris and Prescott 1961
- 5) Rice 1977
- 6) Stroud et al. 1981
- 7) Kajimura et al. 1980
- 8) Walker et al. 1984
- 9) Jones 1981
- 10) Fitch and Brownell 1968
- 11) Fiscus and Niggol 1965 (see also Jones 1984)
- 12) Hacker 1986
- 13) Lowry et al. 1990
- 14) Lowry et al. 1991
- 15) Beach et al. 1981
- 16) Stewart and Yochem 1985
- 17) Brownell 1964
- 18) Walker 1981
- 19) Leatherwood et al. 1982
- 20) Leatherwood 1975
- 21) Spalding 1964
- 22) Kieckhefer 1991

1.7 - Seabird Predators

Pelagic, schooling fish are key components of marine food webs and primary prey of many seabirds. Coastal pelagic species are important to seabirds because of their abundance near the sea surface (which is high relative to other sources of food), relatively small size, fusiform shape, and dense concentration. Seabird populations of the California Current system, and other eastern boundary currents, are large relative to areas not driven by large-scale coastal upwelling.

Two important groups of seabirds feed on coastal pelagic fish: year-round residents and seasonal residents that breed elsewhere, migrate long distances between areas and seasonally tap the rich food supplies available in the California Current. The biomass of seasonally resident seabirds in the California Current greatly surpasses that of permanent residents (Briggs et al. 1987). Seasonal migrants can raise California seabird populations from about 2 million to 7 million birds (Briggs and Chu 1987).

Food is not the only factor that affects abundance of seabirds. Eastern boundary currents, such as the California Current, have abundant fish but few small islands (Parrish et al. 1982). Thus, maximum abundance of year-round residents probably depends more on the availability of island breeding space than on food supplies (Ainley and Boekelheide 1990).

Abundance and reproductive success in seabird communities in eastern boundary current systems are sensitive to fluctuations in prey availability even though maximum abundance of permanent residents depends on breeding space. Seabirds switch from one prey species to another as availability changes seasonally or from year to year. Although anchovies, herring and market squid are currently the primary year-round forage of seabirds off central California (Baltz and Morejohn 1977; Briggs and Chu 1987; David Ainley, Point Reyes Bird Observatory, unpubl. data), euphausiids and juvenile Pacific whiting are important in spring, and juvenile rockfish during the summer chick-rearing season. When juvenile rockfish are not available in summer, many seabirds switch to anchovies. When suitable forage is not available, breeding efforts fail (Ainley and Boekelheide 1990). This has occurred in the recent past only during El Niño and El Niño-like events (i.e., 1973, 1976, 1978, 1982-83 and 1986) (Ainley and Boekelheide 1990).

The best example of how the availability of pelagic fish species affects reproductive success and abundance of seabird populations in eastern boundary current areas comes from the Peru and Benguela currents. The commercial importance of seabird guano in these areas led to intensive efforts to understand trophic relationships between seabirds and fish. In the Benguela region, fishing pressure on sardines and anchovies reduced their abundance and caused seabirds to switch to more abundant prey species not exploited by the fishery (Crawford and Shelton 1978). In some cases, the switch in forage changed the breeding distributions of seabirds. Later, when the initially unharvested species were also fished down, seabird populations declined.

In Peru, a well-documented case, the decline in abundance of the anchoveta and the collapse of the fishery in 1972 was accompanied by reduced seabird populations (Idyll 1973; Glantz and Thompson 1981; Tovar et al. 1987). Some seabirds later increased to the south off Chile as sardines increased there.

In the North Sea, which is not an eastern boundary area, intense fishing on herring, mackerel and cod led to an increase in their prey (sand eels) and a subsequent increase in seabirds. After sand eels were heavily fished, seabird populations declined as well (Furness and Ainley 1984).

1.7.1 - CPS as Forage for Seabirds

CPS are consumed by a large number of seabirds off the coasts of California, Oregon and Washington (Table 1.7.1-1). One shortcoming in the available data is that most studies were conducted during the summer, when adult seabirds were feeding their young (diet data are relatively easy to collect during the feeding period). There is a paucity of diet data for other periods when CPS might be important as forage. Another shortcoming is that most of the available data were collected during the last 30 years when sardines were not abundant or available to seabirds.

Availability of anchovies is known to directly affect the breeding success of pelicans (Anderson et al. 1982), terns (Schaffner 1982), gulls (Hunt and Butler 1980; Ainley and Boekelheide 1990) and auks (Hunt and Butler 1982; Ainley and Boekelheide 1990) in the California Current region. It is likely that many predators of anchovies will also eat sardines when that population increases.

Owing to their size and occurrence near the surface, Pacific mackerel are likely to be important to seabirds, especially in southern California. Pacific mackerel have been observed in the diet of pelicans (D. W. Anderson, Department of Fisheries and Wildlife Biology, University of California, Davis, CA, pers. comm.).

Jack mackerel are probably not important to seabirds, because of their large size and relatively deep schooling habits (MacCall et al. 1980). Studies of seabird diet during autumn, however, when small jack mackerel are nearshore and more available, may indicate their seasonal importance as forage. Baltz and Morejohn (1977) found jack mackerel in the winter diet of murres in Monterey Bay. Much of the data on seabird prey come from identification of otoliths in semidigested gut contents, but mackerel otoliths are small, fragile and hard to detect in stomach samples. The importance of mackerel may, therefore, be underestimated.

Historically, sardines were probably important as forage for seabirds (Ainley and Lewis 1974). Recently, however, sardines have been too sparse to affect reproductive success of most seabirds. The loss of sardines during the mid 1900s shifted the breeding distribution of pelicans (MacCall 1984). As their abundance increases, sardines will probably again become important forage for marine birds. Recent increased abundance of sardines off southern

California was followed by increased breeding success and abundance of brown pelicans (Ainley and Hunt 1991).

Table 1.7.1-1. Seabird species of the West Coast known to forage on anchovies, sardines and Pacific mackerel

Seabird	Forage Species		
	Anchovy	Sardine	P.mackerel
GREBES & LOONS			
<u>Gavia pacifica</u>		*	
<u>Podiceps grisegena</u>			*
PETRELS & ALBATROSSES			
<u>Diomedea nigripes</u>	*		
<u>Fulmarus glacialis</u>	*		
<u>Puffinus griseus</u>	*		*
<u>Puffinus creatopus</u>	*		
<u>Puffinus tenuirostris</u>	*		
<u>Puffinus opisthomelas</u>	*		
<u>Oceanodroma leucorhoa</u>	*		
<u>Oceanodroma homochroa</u>	*		
<u>Oceanodroma melania</u>	*		
PELICANS & CORMORANTS			
<u>Pelecanus occidentalis</u> (ES)	*	*	*
<u>Phalacrocorax auritus</u>	*	*	
<u>Phalacrocorax penicillatus</u>	*		
<u>Phalacrocorax pelagicus</u>	*		
GULLS			
<u>Larus glaucescens</u>	*		
<u>Larus occidentalis</u>	*		
<u>Larus heermanni</u>	*		
<u>Larus delawarensis</u>	*		
<u>Larus californicus</u>	*		
<u>Larus canus</u>	*		
<u>Larus philadelphia</u>	*		
<u>Rissa tridactyla</u>	*		
TERNs			
<u>Sterna elegans</u>	*		
<u>Sterna caspia</u>	*		
<u>Sterna forsteri</u>	*		
<u>Sterna albifrons</u> (ES)	*		
AUKS			
<u>Uria aalge</u>	*		
<u>Uria lomvia</u>	*		
<u>Cepphus columba</u>	*		
<u>Fratercula cirrhata</u>	*	*	
<u>Cerorhinca monocerata</u>	*	*	
<u>Brachyramphus marmoratus</u> (TS)	*		
<u>Synthliboramphus antiquus</u>	*		
<u>Synthliboramphus craveri</u>	*		
<u>Synthliboramphus hypoleuca</u>	*		
<u>Ptychoramphus aleuticus</u>	*		
RAPTORS			
<u>Haliaeetus leucocephalus</u> (ES)	*		
<u>Pandion haliaetus</u>	*		

Endangered (ES) and threatened species (TS) are indicated.

2.0 - Fishery Components

Two general groups of west coast pelagic and midwater fisheries are described in this section. The first is the "inshore component," which has historically been most important for harvesting CPS. This component involves both commercial and recreational fishing, but consists primarily of small commercial vessels that operate off southern California and take CPS in directed fishing with round haul gear or as bycatch with other types of gear.

The second component consists of fisheries for Pacific whiting and two species of groundfish off Washington, Oregon and California, as well as for walleye pollock and other species in the north Pacific. These fisheries' current take of CPS is minimal but may increase in the near future. This component includes a variety of vessel types operating primarily off northern California, Oregon, Washington and Alaska.

2.1 - Inshore Component

The inshore component includes the fisheries for Pacific sardine (Sardinops sagax), jack mackerel (Trachurus symmetricus), Pacific mackerel (Scomber japonicus) and northern anchovy (Engraulis mordax), jointly referred to as coastal pelagic species, or CPS. Although market squid (Loligo opalescens) is not covered by the Fishery Management Plan for Coastal Pelagic Species, it is also included in this description for several reasons: (1) squid is an important source of income for many round haul vessels that also target CPS; (2) the squid fleet includes fishers who were formerly involved in the sardine fishery, and might wish to resume participation in that fishery as it recovers; and (3) industry representatives have asked that squid as well as CPS landings be considered in developing criteria for license limitation.

The fisheries for CPS and squid are largely concentrated in California. Thus the following description focuses on the coastal fisheries of California, but also provides some information on CPS landings in Oregon, Washington and Mexico.

2.1.1 - History of Landings and Regulations

Commercial landings of CPS and squid are monitored (as are all commercially caught species of finfish and shellfish) via information provided by processors in the form of "fish tickets." The California Department of Fish and Game (CDFG) conducts a port sampling program to estimate the species composition of mixed loads of sardine, Pacific mackerel and jack mackerel, which are usually reported as "unspecified mackerel" on fish tickets. Table 2.1.1-1, which describes commercial landings of CPS and squid from 1916 to 1991, is based on fish ticket data adjusted with port sampling information to more accurately reflect the species composition of mixed loads.

Landings of CPS in California fluctuated widely during 1916-91 (Table 2.1.1-1), largely in response to changes in abundance and market conditions. The CPS fisheries are currently in a period of transition. Sardines are showing increasing signs of recovery after the fishery's collapse in the 1940s, while market and biological conditions are contributing to declining landings of anchovy and Pacific mackerel.

2.1.1.1 - Pacific Sardine

The sardine fishery developed in response to an increased demand for protein products that arose during World War I. The fishery developed rapidly and became so large that by the 1930s sardines accounted for almost 25% of all fish landed in the United States (Frey 1971). Coastwide landings exceeded 350,000 MT each season from 1933/34 to 1945/1946; 83% to 93% of these landings were made in California, the remainder in British Columbia, Washington and Oregon (Table 2.1.1-2).

In the late 1940s, sardine abundance and landings declined dramatically (MacCall 1979; Radovich 1981). The decline has been attributed to a combination of overfishing and environmental conditions, although the relative importance of the two factors is still open to debate (Clark and Marr 1955). This reduced abundance was accompanied by a southward shift in the range of the resource and landings (Radovich 1981). As a result, harvests ceased completely in British Columbia, Washington and Oregon in the late 1940s, but significant amounts continued to be landed in California through the 1950s (Table 2.1.1-2). Sardine landings in Washington and Oregon have remained virtually nil.

During 1967, in response to low sardine biomass, the California legislature imposed a two-year moratorium that eliminated directed fishing for sardine, and limited the take to 15% by weight in mixed loads (primarily jack mackerel, Pacific mackerel and sardines); incidentally taken sardines could be used for dead bait. In 1969, the legislature modified the moratorium by limiting dead bait usage to 227 MT (250 short tons). From 1967 to 1974, a lucrative fishery developed that supplied dead bait to striped bass anglers in the San Francisco Bay-Delta area. Sardine biomass remained at low levels and, in 1974, legislation was passed to permit incidentally taken sardines to be used only for canning or reduction. The law also included a recovery plan for the sardine population, allowing a 907-MT (1,000-short ton) directed quota when the spawning population reached 18,144 MT (20,000 short tons), with increases as the spawning stock increased further.

In the late 1970s and early 1980s, the California Department of Fish and Game began receiving anecdotal reports about the sighting, setting and dumping of "pure" schools of juvenile sardines, and the incidental occurrence of sardines in other fisheries, suggesting increased abundance (CDFG 1986). In 1986 the state lifted its 18-year moratorium on sardine harvest on the basis of sea-survey and other data indicating that the spawning biomass had exceeded 18,144 MT (20,000 short tons). The state also passed

other legislation during the mid and late 1980s to establish live and dead bait quotas for sardine.

In accordance with the recovery plan specified by law, the annual directed quota was 907 MT (1,000 short tons) during 1986-90; it was increased to 7,394 MT (8,150 short tons) in 1991, and to 18,597 MT (20,500 short tons) in 1992. Legislation passed in 1988 permitted an annual dead bait quota of 227 MT (250 short tons) when the directed quota was less than 2,268 MT (2,500 short tons) and 454 MT (500 short tons) when the directed quota exceeded 2,268 MT. In accordance with the law, the dead bait quota was 227 MT (250 short tons) during 1986-90 and 454 MT (500 short tons) thereafter. A live bait quota of 68 MT (75 short tons) was established in 1984; it was increased to 136 MT (150 short tons) in 1985, 318 MT (350 short tons) in 1988, and 907 MT (1,000 short tons) in 1992. Although the sardine population appears to be rebounding, the timetable for recovery and development of markets is uncertain at this time.

2.1.1.2 - Jack Mackerel

Before 1947, jack mackerel was marketed as fresh fish. It was taken in relatively small amounts in loads consisting primarily of sardine and Pacific mackerel (Frey 1971; Mason 1991). The market for jack mackerel was relatively small, since Pacific mackerel was preferred by consumers. In 1947, the industry began marketing jack mackerel as a substitute for Pacific mackerel and sardine as landings and biomass of these two species declined. In 1948, in a move that facilitated consumer acceptance of jack mackerel products, the U.S. Food and Drug Administration authorized use of the label "jack mackerel" for Trachurus symmetricus instead of "horse mackerel" (Frey 1971). During 1947-78, jack mackerel dominated "mackerel" landings in all but three years. The general decline in jack mackerel landings after 1978 coincided with an increase in Pacific mackerel abundance and landings (Table 2.1.1-1). Since 1947, jack mackerel has been sold largely in the form of canned products for human consumption and pet food.

Jack mackerel is also harvested in California's recreational fishery as bait and incidental take, and as a target species. Available information on harvest levels is somewhat sketchy but generally indicates that anglers catch jack mackerel in relatively modest amounts.

In 1983, jack mackerel, which was being taken incidentally in the expanding Pacific whiting fishery, was added to the list of species covered by the Pacific Fishery Management Council's Groundfish FMP. Each year from 1983 to 1990, the FMP specified an allowable biological catch (ABC) of 12,000 MT and an equivalent amount as a quota. The possibility of a joint-venture fishery for jack mackerel prompted the council to raise the ABC to 52,600 MT and the quota to 46,500 MT in 1991. All FMP regulations apply to the fishery north of 39° N latitude; the fishery south of 39°, which includes southern California's coastal fishery, is not regulated.

2.1.1.3 - Pacific Mackerel

Before 1928, Pacific mackerel was taken incidentally with sardines and sold as fresh fish (Frey 1971). As markets developed for canned Pacific mackerel, landings increased to a high of 66,000 MT in 1935 (Table 2.1.1-1). Harvests subsequently underwent a long-term decline, reaching record low levels in the early 1970s. In 1970 the state of California imposed a moratorium on harvest, with a small allowance for incidental catch in mixed loads.

The incidental take of Pacific mackerel with jack mackerel increased dramatically in 1977 as the result of a very successful spawning of Pacific mackerel in 1976 (Prager and MacCall 1988). The state initially responded to this resurgence by increasing the tolerance of Pacific mackerel in mixed loads, and subsequently established a directed quota. By 1979, with the advent of another strong year class in 1978, Pacific mackerel was contributing more than jack mackerel to the "mackerel" fishery (Klingbeil 1983), a pattern which continues (CDFG 1991b). Pacific mackerel is sold largely in the form of canned products for human consumption and pet food.

Current state regulations on the commercial fishery (1) specify a quota of 30% of the population above 18,144 MT (20,000 short tons) when total biomass is between 18,144 and 136,079 MT (20,000-150,000 short tons) and (2) allow unrestricted harvest when the biomass exceeds 136,079 MT.

Pacific mackerel is also harvested in California's recreational fishery as bait and incidental take and as a target species. During 1981-89, the recreational harvest of Pacific mackerel in southern California averaged about 1,150 MT (2.8 million fish) per year and accounted for 10%-15% by weight (13%-27% by numbers of fish) of the sport harvest of all species in the area (Table 2.1.1-3). Pacific mackerel is also caught by anglers in northern California but in very modest amounts. The statewide sport harvest constitutes a small fraction (2%-3% by weight) of total combined sport and commercial landings of Pacific mackerel.

There is no directed fishery for mackerel in Oregon or Washington, although small amounts are taken incidentally by commercial jig boats and trawlers (Table 2.1.1-4).

2.1.1.4 - Northern Anchovy

Anchovy landings, which were relatively low during 1916-46, surged in 1947, when the scarcity of Pacific sardines prompted processors to begin canning anchovies in quantity (Frey 1971). Landings for reduction were limited by restrictions imposed by the California Fish and Game Commission. Over the next two decades anchovy landings increased and then declined with changes in consumer demand for canned anchovies (Table 2.1.1-5).

In late 1965 the California Fish and Game Commission authorized a quota for an experimental anchovy reduction fishery. Increases in abundance and in prices for fish meal and oil raised reduction landings to record highs by the mid 1970s. Reduction

landings declined somewhat in the late 1970s and early 1980s, when fishermen diverted more effort to Pacific mackerel, which was increasing in abundance. Anchovy landings have been extremely low since 1983 because low ex-vessel prices offered by reduction processors prompted the fleet to fish for other species (Thomson 1990; Thomson et.al. 1991; Jacobson and Thomson, in press). The effects of low prices have been compounded in recent years by low abundance (Jacobson and Lo 1991).

Modest amounts of anchovy were harvested for live bait before World War II. Live bait harvests fell to zero during the war years and, since that time, have ranged from 3,500 to 7,000 MT per year. Landings for other nonreduction uses (such as dead bait and canned, fresh or frozen products for human consumption) during 1965-91 ranged from about 250 to 5,800 MT and were almost always lower than live bait harvests (Table 2.1.1-5).

Small amounts of anchovy (from the northern subpopulation) are harvested by commercial albacore vessels in Oregon and Washington. Only two boats in Washington and none in Oregon are known to sell anchovy as bait to the recreational fishery, where Pacific herring is the preferred bait (Table 2.1.1-4).

In 1978 the Northern Anchovy Fishery Management Plan (FMP) was drafted, and federal authorities assumed management of the anchovy fisheries. The FMP has been amended six times, most recently in 1991 (PFMC 1983, 1990). Current regulations specify an optimum yield (OY) for the reduction fishery of: (1) zero, if the estimated spawning biomass is less than or equal to 300,000 MT, or (2) 100% of the spawning biomass above 300,000 MT, up to a limit of 200,000 MT, if the spawning biomass is greater than 300,000 MT.

The FMP imposes no numeric limit on live bait catch and provides a 7,000-MT quota for other nonreduction uses. Overfishing is defined in the FMP in terms of a spawning biomass criterion. If the spawning biomass falls below 50,000 MT for two consecutive years, all harvests (including those for live bait and other nonreduction purposes) are disallowed until the spawning biomass exceeds 50,000 MT.

Although Mexico also harvests anchovy (see Section 2.1.4), there is no bilateral agreement between the United States and Mexico regarding anchovy management. In the absence of an agreement, the FMP for northern anchovy allocates 70% of total OY to the U.S. reduction fishery and 30% to Mexican fisheries. Similarly, 70% or 4,900 MT of the 7,000-MT quota for nonreduction uses (other than live bait) can be taken in the U.S. Exclusive Economic Zone.

2.1.1.5 - Market Squid

The squid fishery in California was established in 1863 by immigrant Chinese fishermen in Monterey Bay. The method of fishing involved three skiffs: one carried a torch at its bow to attract squid while the other two encircled the school with a small purse seine. The harvest was sun-dried and exported to China. In 1905, Italian fishermen introduced the more efficient lampara net, which

soon became the principal gear in the squid fishery. Asian immigrants continued to dry and market squid abroad (Frey 1971).

Domestic markets for canned squid developed in 1920 and for frozen squid in 1926. These products became dominant when the Asian market declined in 1933. Squid harvests increased during World War II, peaking in 1946 as a result of demand by United States and international aid programs (Frey 1971). Landings have steadily increased since 1950, averaging 4,945 MT per year during 1950-60, 7,947 MT during 1961-70, 11,547 MT during 1971-80, and 20,023 MT during 1980-90. Landings reached a record high of 40,893 MT in 1989 (Table 2.1.1-6). Most of the harvest is canned or frozen for export; smaller amounts are used domestically for human consumption and as live and dead bait.

The commercial squid fishery consists of two distinct segments: a southern California fall-winter fishery and a central California (Monterey Bay) spring-summer-fall fishery. Southern California's share of statewide squid landings, which averaged 54.2% during 1970-85, increased to 77.1% during 1986-91 (Table 2.1.1-6). Fishing in southern California is concentrated around the Channel Islands.

During the 1970s, scoop boats, using a power-assisted brail or dip net in conjunction with attracting lights, were the major harvesters in the southern California fishery (Kato and Hardwick 1975). Local purse seiners also targeted squid when CPS were not available. During the 1980s, however, purse seines became the predominant gear in southern California. Many of the scoop boats now work in partnership with the purse seiners; for a percentage of the landed value a scoop boat will use lights to attract squid, which are subsequently wrapped and landed by a seiner.

Purse seines were outlawed in Monterey Bay in 1953, and attracting lights in 1959; lampara nets have predominated in that area until very recently (Kato and Hardwick 1975). On the basis of preliminary results from a 1987-88 study indicating that purse seines have no greater impact on squid spawning or egg-case mortality than lampara nets, CDFG began allowing purse seine gear in Monterey Bay in 1989. Other legislation passed that same year allowed attracting lights in the bay. Many of the Monterey lampara boats have invested in light systems and switched to half-purse drum seines, which require fewer crew members than the traditional purse seine (CDFG 1991a).

Squid are subject to natural cyclical changes in abundance. They are short-lived (with a maximum life span of two years) and tend to rebound well after a poor recruitment. There are no regulatory restrictions on squid harvest.

2.1.2 - Commercial Fisheries

This section describes the harvesting and processing sectors of the commercial fisheries as they relate to CPS and squid.

2.1.2.1 - Harvesters

Tables 2.1.2-1 through 2.1.2-10 are based on vessel summaries generated from WOC (Washington, Oregon and California) fish ticket data converted to PacFIN (Pacific States Fisheries Information Network) format. Several points should be kept in mind in interpreting the tables:

1. The PacFIN gear category ONT or "Other Net" includes: (a) round haul gears (encircling nets such as purse seines, drum seines and lampara nets) and (b) net gears of unspecified type. Thus, in addition to round haul gears, ONT may also include gill net, trawl and other net gears not specifically identified as such on the fish tickets. All gears coded as ONT in the PacFIN data base are loosely referred to as "round haul" in Tables 2.1.2-1 through 2.1.2-10, although they include unspecified net gears as well as round haul gears.

2. The gear category described in Tables 2.1.2-1 through 2.1.2-10 as "Other/Unknown" includes (a) specific gears other than round haul/unspecified net, line, pot/trap, dip net, trawl or gill net (i.e., dredge and harpoon), and (b) gears that were unreadable or missing from fish tickets and therefore unknown. Thus, in addition to including dredge and harpoon, "Other/Unknown" also includes gear types that were unidentifiable on the fish tickets.

Table 2.1.2-1 describes the amount of CPS and squid harvested in WOC by gear type during 1981-90. In each of these years, 99%-100% of the anchovy, mackerel and sardine landings were made with round haul or other/unknown gear. Other/unknown probably includes some round haul landings that were not specified as such on the fish tickets. During 1981-90, 98%-100% of the squid landings were made with round haul, dip net or other/unknown gears. Round haul rather than dip net gear has been responsible for an increasing percentage of the landings in recent years. As indicated in Section 2.1.1.5, many of the scoop boats that once dominated the fishery now work in partnership with the purse seiners as light boats. The gist of Table 2.1.2-1 is that CPS and squid are landed largely with round haul gear, and modest amounts are taken incidentally with other gears.

Table 2.1.2-2 describes the number of vessels that landed any CPS or squid during 1981-90, according to the vessel's principal gear as defined by plurality of landings—i.e., the gear with which the vessel made most of its landings during the year. The vessels are further categorized according to where (California, Oregon, Washington or joint venture) they made most of their landings. On an annual basis, about 50%-75% of the boats in the table landed CPS but no squid; the remainder is split between boats landing both CPS

and squid and boats landing squid but no CPS. California vessels clearly dominate the geographic distribution. In each year a plurality if not the majority of boats landing CPS or squid were round haulers; line vessels (e.g., trollers, longliners) were the second most common.

Table 2.1.2-3 distinguishes vessels that landed any CPS or squid during 1981-90 on the basis of whether or not their principal gear was round haul, and on where (California, Oregon, Washington or joint venture) they made most of their landings. It further categorizes the round haul vessels according to whether they landed: (i) less than 50 MT of CPS+squid, (ii) at least 50 MT of squid but no CPS, (iii) some CPS and at least 50 MT of CPS+squid, or (iv) at least 50 MT of CPS during the year.

The number of round haulers in the first category increased significantly from the early to the late 1980s (Table 2.1.2-3). Two possible reasons for this increase are:

1. Anecdotal information indicates that the fresh market for CPS expanded in the mid to late 1980s, largely in response to demand by California's increasing Asian immigrant population. The expansion of this market, which is serviced by a small-volume directed fishery, may be reflected by an increased number of round haul vessels landing small amounts of CPS/squid.

2. As indicated previously, the PacFIN gear code that includes round haul gear also includes unspecified net gears. Thus, the apparent increase in the number of round haulers landing less than 50 MT of CPS+squid may partially represent an increased number of boats whose principal gear is an unspecified net gear, as well as a true increase in the number of round haulers landing small amounts of CPS/squid. This issue will be further addressed in Table 2.1.2-12.

Landings categories ii through iv include round haul vessels that landed at least 50 MT of squid, CPS+squid or CPS annually during 1981-90. The 50 to 79 vessels included in these categories represent the more active participants in the fishery. Since round haul gear is customarily used to target CPS and squid, these vessels are likely to be true round haulers and not affected by the ambiguities discussed above.

Table 2.1.2-4 describes the total number of vessels in WOC that landed any CPS or squid during 1981-90 and the proportion of these vessels in five categories: non-round haul vessels, and round haulers in each category described in Table 2.1.2-3. The table also describes total annual landings of CPS and squid in WOC during 1981-90 and the proportion of these landings accounted for by vessels in each of the five categories. Three general patterns can be discerned from the table:

1. Although the non-round haulers and round haulers in landings category i together made up most of the vessels that landed any CPS or squid each year, these vessels accounted for a very small proportion of total CPS and squid landings. For instance, these vessels constituted 83.9% of all vessels that landed any CPS or squid in 1990, but accounted for only 3.9% of total CPS landings and 4.7% of squid landings in that year.

2. Round haulers in landings categories ii and iii harvested zero to negligible amounts of CPS but a disproportionate amount of squid. For instance, in 1990 these vessels constituted 3.1% of all vessels that landed any CPS or squid and accounted for 0.2% of total CPS landings and 25.3% of total squid landings.

3. Category iv round haulers landed a disproportionate amount of both CPS and squid during 1981-90. For instance, while these vessels constituted 13.0% of all vessels landing any CPS or squid during 1990, they accounted for 95.9% of total CPS landings and 70.0% of total squid landings during that year.

Tables 2.1.2-5 through 2.1.2-10 describe the vessels in landings categories i through iv in terms of selected characteristics, summarized in Table 2.1.2-11 as follows:

1. During 1981-90, an average of 75 round haulers fell into landings category i, 6 into category ii, 10 into category iii and 49 into category iv (Table 2.1.2-5).

2. During 1981-90, the median vessel length was 31-40 feet for category i vessels, 41-50 feet for categories ii and iii vessels, and 51-60 feet for category iv vessels (Table 2.1.2-5).

3. The vessels in categories ii and iii constitute a fairly modern fleet; 90.9% of these boats were built after 1970. Category i vessels include a higher proportion of older boats; 54.5% of these boats were built after 1970, and 12.7% were built before 1951. Category iv vessels fall into two distinctly different age groups; 50% were built before 1951 during the heyday of the sardine fishery, and 47.7% were built after 1970 (Table 2.1.2-6).

4. Category i vessels tend to be geographically dispersed throughout southern and central California. The major ports of landing for vessels in categories ii and iii are in the Monterey area and, to a lesser extent,

in Ventura and Santa Barbara counties. Category iv vessels are geographically concentrated in Orange and Los Angeles counties (particularly San Pedro) and, to a lesser extent, in Ventura and Santa Barbara counties (Port Hueneme) and in Monterey Bay (Table 2.1.2-7).

5. During 1981-90, category i vessels made an average of 47.2 fishing trips per vessel year, landing 20.8 MT of fish (all species) with an ex-vessel value of \$29,000.

6. During 1981-90, vessels in categories ii and iii exhibited very similar patterns of fishing activity. Both groups made about 55 fishing trips per vessel year and earned over \$160,000 per vessel year in revenues. For both groups, squid accounted for over three-fourths of total landings and over 60% of total revenues.

7. During 1981-90, category iv vessels made an average of 65.7 fishing trips per vessel year, landing 1,605 MT with an ex-vessel value of \$443,300. CPS accounted for 77.4% of their landings and 57.9% of their revenues, while squid accounted for an additional 14.6% of landings and 11.8% of revenue.

In addition to harvesting CPS and squid, round haul vessels also target Pacific bonito (Sarda chiliensis) and bluefin tuna (Thunnus thynnus) in southern California, and Pacific herring (Clupea harengus pallasii) in central California. These three species account for most of the non-CPS and non-squid landings made by vessels in categories ii, iii and iv.

Category i vessels, however, followed a pattern atypical of round haulers, particularly after 1983. Table 2.1.2-12 contrasts the fishing patterns of these vessels during two time periods: 1981-83 and 1984-90. The number of vessels in category i increased from an annual average of 27 boats in the first period to 96 boats in the second period. Although these vessels were approximately equally distributed between southern and central California during the first period, the distribution then shifted significantly toward southern California. The mean number of fishing trips per vessel year more than doubled, and the proportion of trips on which any CPS or squid were taken declined significantly between the two periods. Whereas 89.5% of all landings and 71.0% of total revenues during the first period consisted of species traditionally targeted with round haul gear (CPS, squid, bonito, tuna and herring), these species accounted for only 38.0% of total landings and 25.5% of total revenues in the second period. Conversely, landings of shark, swordfish, groundfish and flatfish increased from 5.3% during 1981-83 to 40.9% during 1984-90; revenues from these species increased from 18.7% in the first period to 64.5% in the second period.

The anomalous pattern of category i vessels may be due to the ambiguities in the PacFIN gear code for round haul vessels. As previously indicated, the code ONT or "Other Net" includes round haul gears and net gears of unspecified type. One possible reason for the high numbers of shark, swordfish, groundfish and flatfish caught by category i vessels during 1984-90 (Table 2.1.2-12) may be that significant numbers of gill net landings of shark, swordfish, rockfish and halibut (species customarily targeted with this gear) were reported on fish tickets during this period as unspecified net gear rather than gill net gear. If this is true, these gill netters would appear in the data base as category i round haulers rather than as gill netters. In fact, according to Table 2.1.2-2, the number of gill netters that landed any CPS or squid declined from an annual average of 59 vessels during 1981-83 to 3 vessels during 1984-90. This apparent decline closely matches the increase in the number of category i round haulers during the same period (Table 2.1.2-12).

2.1.2.2 - Markets and Ex-Vessel Prices

Table 2.1.2-13 describes mean ex-vessel prices of anchovy, mackerel, sardine, squid, bonito and bluefin tuna caught with round haul gear during 1981-90. These prices reveal general trends but tend to obscure the wide range and multiple peaks in the price distributions, which are depicted in Figures 2.1.2.2-1a to 2.1.2.2-1d. All prices are based on WOC fish ticket data converted to PacFIN format.²

Prices and markets can be described as follows:

1. Anchovy is used for a variety of purposes, including reduction, live and dead bait, and human consumption. Although live bait harvest is not regulated, all other harvests are subject to separate reduction and nonreduction quotas. CDFG distinguishes between landings (without relying on the disposition code on fish tickets) by attributing landings received at known reduction plants to the reduction quota and all other landings to the nonreduction quota.³

² Since prices tend to vary significantly by disposition of catch, it would have been informative to report average prices by disposition. However, the disposition codes reported on the California fish tickets were not deemed sufficiently reliable to do this.

³ Live bait harvests, which are not limited by quota, are reported on logbooks maintained by bait haulers and not on the fish tickets.

Reduction landings, which generally receive a much lower ex-vessel price than nonreduction landings, have been exceedingly low since 1983 (Table 2.1.1-5), when the price fell below \$50/MT. Nonreduction landings have increased in recent years, largely as a result of increased exports for human consumption. While still low, nonreduction landings now dominate total anchovy landings (Table 2.1.1-5).

The predominance of reduction landings during 1981-82 is reflected in the low average prices (Table 2.1.1-13) and the high proportion of landings associated with low prices (Figure 2.1.2.2-1a) in those years. From 1983 onward, total landings were lower (Table 2.1.1-5) but prices were higher (Table 2.1.2-13) (Figure 2.1.2.2-1a), reflecting the shift from reduction to higher-priced uses.

2. Commercially harvested mackerel is processed into canned products for pet food and human consumption, and a small but increasing amount is sold to fresh fish markets that cater to California's growing Asian immigrant population. Sardines landed in mixed loads with mackerel receive the same price as mackerel and are processed into the same products. Thus the mackerel prices described in Table 2.1.2-13 and Figure 2.1.2.2-1b pertain to sardine taken incidentally with mackerel as well as to "pure" mackerel landings.

The peaks in the price distributions are probably cannery landings, which constitute the bulk of the landings each year. The distribution of the peaks probably reflects price differentials between cannery landings for pet food and human consumption, with pet food receiving the lower prices. The mackerel price distribution has shifted downward over the years, coinciding with a general decline in cannery prices (Figure 2.1.2-1b).

3. Average sardine prices for 1981-90 are described in Table 2.1.2-13, but corresponding price distributions (Figure 2.1.2.2-1c) are provided only for 1986-90. Because of the moratorium, pre-1986 landings were too low (Table 2.1.1-1) to provide any meaningful distribution of prices for these earlier years. All prices pertain to landings that are sold as canned and fresh products for human consumption and as dead bait. The average sardine price, which was \$233/MT in 1986 when the moratorium was lifted, declined to \$132/MT by 1990.

4. Squid are generally frozen or canned and exported for human consumption. Smaller amounts are sold domestically in the fresh markets and used for live and dead bait by commercial and recreational fisheries. Ex-vessel prices vary with the disposition of catch; landings for human consumption receive a higher price than frozen bait landings. Prices tend to be lower in southern California than in central and northern California.

The general increase in landings since the early 1980s (Table 2.1.1-1) has been accompanied by a steady decline in average prices (Table 2.1.2-13). This decline is also reflected in the downward shift of the price distribution (Figure 2.1.2.2-1d).

5. Bonito and bluefin tuna are important sources of income to category iv round haulers (i.e., the 50 or so southern California purse seiners that land at least 50 MT of CPS during the year; see Tables 2.1.2-9 and 2.1.2-10). These species vary in availability both seasonally and annually and command considerably higher prices than CPS or squid.

Bonito are generally sold as canned, fresh and frozen products for human consumption. Mean annual prices ranged from \$250 to \$800/MT and averaged \$470/MT during 1981-90.

The bluefin price was extraordinarily high (\$5,437/MT) in 1988, when record-size bluefin were landed by San Pedro purse seiners and sold at premium prices in the Japanese sashimi market (Thomson et al. 1989). The average price during 1981-90 (excluding 1988) was \$1,940/MT.

2.1.2.3 - Fish Dealers

Tables 2.1.2-14 to 2.1.2-17 provide information on California fish dealers who received any CPS or squid during 1986-90. These tables are based on dealer summaries generated from California fish ticket data. Several points should be kept in mind in interpreting the tables:

1. Fish sometimes pass through several middlemen between the point of landing and the final market. The dealer reported on the fish ticket represents the first transaction after the fish are landed.

2. Each dealer code is specific to a particular plant belonging to a particular fish processing or distributing company. Thus a company with multiple plants would be represented by multiple dealer codes in the data base.

3. Sometimes a dealer will set up receiving stations at several ports and truck the landings to the processing plant. Since the port reported on the fish tickets reflects where the landing is made and not the location of the plant, the tickets sometimes show a single dealer receiving landings from several different ports. Thus each dealer's principal landing area is defined in Tables 2.1.2-14 and 2.1.2-15 as the area from which he received most of his landings.

During 1986-90, 134 to 152 California dealers purchased CPS or squid from commercial fishing vessels each year (Table 2.1.2-14). Tables 2.1.2-15 to 2.1.2-17 categorize these dealers according to whether they purchased (i) less than 500 MT of CPS+squid, (ii) at least 500 MT of squid but no CPS, (iii) some CPS and at least 500 MT of CPS+squid, or (iv) at least 500 MT of CPS during the year. The tables can be summarized as follows:

1. During 1986-90, an average of 53.8% of the category i dealers received most of their landings in southern California (San Diego to Santa Barbara counties); 42.2% received most of their landings in central California (San Luis Obispo to San Francisco Bay); and 4.1% received most of their landings in northern California (Table 2.1.2-15). These dealers received an average of 227.6 MT of fish (all species) per year, of which 4.8% consisted of CPS and 5.5% consisted of squid (Table 2.1.2-16). Although these dealers accounted for 86.2% of all dealers who received any CPS or squid during the year, they accounted for only 2.4% of total CPS landings and 5.5% of total squid landings made in California (Table 2.1.2-17).

2. During 1986-90, 41.6% of category ii and iii dealers received most of their landings in southern California; the other 58.4% received most of their landings in central California (Table 2.1.2-15). These dealers tend to handle higher volumes of raw product and to be much more dependent on squid than category i dealers. During 1986-90, they received an average of 1,934.5 MT of fish (all species) per year, 7.4% of which was CPS, and 73.1% squid (Table 2.1.2-16). While categories ii and iii made up only 4.3% of all CPS/squid dealers in California, they received a disproportionate 28.5% of total squid landings in California (Table 2.1.2-17).

3. Category iv dealers are located predominantly in southern California; they derive most of their raw product from CPS or squid and account for most of the CPS and squid landings made in the state. From 1986 to 1990, 84.5% of the category iv dealers received most of their landings in southern California, and 15.5% received most

of their landings in central California. These dealers received an average of 7,384.4 MT of fish (all species) per year, 55.1% of which was CPS and 19.5% squid (Table 2.1.2-16). Although these dealers made up only 9.4% of dealers receiving any CPS or squid during the year, they accounted for 96.2% of total CPS landings and 66.0% of total squid landings in California (Table 2.1.2-17).

2.1.3 - Recreational Fisheries

According to the Marine Recreational Fishery Statistics Survey, about 7-10 million marine recreational fishing trips are taken in California each year (Table 2.1.3-1). These figures underestimate the true level of fishing activity, because they do not include trips targeted on salmon or striped bass, or trips aboard commercial passenger fishing vessels (CPFV's)⁴ and private boats that originate in the United States but fish in Mexican waters. Annual fishing expenditures are approximately \$500 million in southern California (Thomson and Crooke 1991) and \$180 million in central and northern California (Thomson and Huppert 1987).

As indicated in Section 2.1.1.3, Pacific mackerel accounts for about 8%-12% (by weight) of the sport harvest of all species in southern California. In addition, anchovy is the major source of bait for the recreational fishery in both southern and northern California. In southern California, anchovy is used as bait on approximately 35% of beach trips, 66% of pier trips, 84% of CPFV trips and 71% of private boat trips (Table 2.1.3-2), and is more likely to be used live than dead (at least for boat-based trips). In northern California, anchovy is used almost exclusively as dead bait.

The live bait fleet consists of approximately 18 boats that are distributed along the southern California coast to conveniently service the principal sportfishing markets. Two types of gear are used in the fishery: (1) the lampara net, which is set in shallow water and cannot be used effectively in deeper water offshore; and (2) the more versatile drum seine, which can be set in deep as well as shallow water and used to harvest mackerel as well as anchovies. The drum seine is of more recent origin, and six boats in the fleet currently use this gear. The live bait boats fish for a variety of species other than anchovy, such as squid, sardine, mackerel, white croaker and queenfish. Anchovies, however, constitute approximately 85% of the live bait catch.

About 20% of the live bait harvest is sold to anglers aboard private boats for \$20 per scoop; at 5.67 kg (12.5 lbs) per scoop, the ex-vessel price for such sales is about \$3,500 per MT. Live bait haulers sell the rest of their bait to CPFV's. The value of

⁴ Commercial passenger fishing vessels (CPFV's) transport paying passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental and fish cleaning.

these sales is difficult to pinpoint, since bait haulers receive 12.5%-16.0% of the CPFV's gross revenues rather than a fixed price.

2.1.4 - Mexican Fisheries

In 1962, Mexico began harvesting anchovy, primarily for reduction. Mexico's harvesting and processing capacity increased significantly in the late 1970s, due to the addition of a number of large seiners to the fleet and the construction of a large reduction plant in Ensenada. Mexican landings reached a high of 258,700 MT in 1981, fell to 178,000 MT in 1982, and ranged from 79,000 MT to 124,000 MT per year during 1983-89. Mexican landings surpassed U.S. landings during 1977-89 and constituted more than 90% of total landings during 1983-89. In 1990, Mexican landings fell to a record low of 99 MT (Table 2.1.1-5). In 1991 the large reduction facility in Ensenada closed, although smaller plants remain open. Overfishing, changing environmental conditions and low demand have been cited as reasons for the fishery's demise.

Sardine and Pacific mackerel are harvested in substantial amounts in Mexico as well as in the United States. Mexican landings of sardine in Ensenada (Table 2.1.4-1) exceeded U.S. landings (Table 2.1.1-1) in 1989 by a factor of 1.6 and in 1990 by a factor of 3.6. In 1990, Mexican landings of Pacific mackerel in Ensenada (Table 2.1.4-1) exceeded U.S. landings (Table 2.1.1-1); combined U.S.-Mexican landings probably exceeded the OY for Pacific mackerel in that year.

Table 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific mackerel and market squid in California (MT), 1916-1991

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific Mackerel	Total Mackerel	Market Squid	Grand Total
1916	241	7,098	n.a.	n.a.	505	125	7,969
1917	240	47,221	n.a.	n.a.	1,518	199	49,178
1918	394	71,511	n.a.	n.a.	1,817	164	73,886
1919	730	69,798	n.a.	n.a.	1,204	1,678	73,410
1920	258	53,761	n.a.	n.a.	1,360	231	55,609
1921	883	26,913	n.a.	n.a.	1,322	196	29,314
1922	296	42,366	n.a.	n.a.	1,119	95	43,876
1923	139	71,741	n.a.	n.a.	1,612	535	74,027
1924	157	110,082	n.a.	n.a.	1,464	3,099	114,801
1925	42	143,017	n.a.	n.a.	1,590	858	145,507
1926	27	130,065	107	1,638	1,744	1,422	133,259
1927	167	155,255	210	2,145	2,355	2,728	160,505
1928	162	190,633	244	15,990	16,234	613	207,643
1929	174	295,642	317	26,297	26,614	2,114	324,543
1930	145	227,734	167	7,499	7,666	4,976	240,521
1931	140	165,269	255	6,466	6,721	789	172,918
1932	136	191,695	243	5,658	5,901	1,919	199,650
1933	144	284,132	459	31,577	32,035	374	316,685
1934	117	507,997	717	51,641	52,359	694	561,167
1935	81	497,033	4,529	66,419	70,948	370	568,432
1936	89	663,859	2,086	45,606	47,692	429	712,068
1937	103	486,025	2,967	27,641	30,608	228	516,963
1938	334	464,206	1,875	36,219	38,094	725	503,359
1939	974	526,533	1,706	36,700	38,406	527	566,440
1940	2,876	410,947	650	54,660	55,310	817	469,940
1941	1,862	572,657	938	35,456	36,395	649	611,563
1942	769	439,874	2,426	23,838	26,264	428	467,336
1943	713	441,019	5,760	34,117	39,887	4,157	485,766
1944	1,765	520,370	5,796	37,947	43,742	4,961	570,838
1945	733	383,318	4,097	24,366	28,463	6,906	419,421
1946	872	231,679	6,846	24,438	31,284	17,248	281,082
1947	8,591	115,900	58,536	21,082	79,619	6,597	210,707
1948	4,915	164,219	33,067	17,865	50,932	8,734	228,800
1949	1,507	287,299	23,247	22,576	45,823	3,111	337,740
1950	2,213	324,105	60,444	14,810	75,254	2,720	404,293

Table 2.1.1-1 (cont.)

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific Mackerel	Total Mackerel	Market Squid	Grand Total
1951	3,155	149,188	40,750	15,204	55,954	5,617	213,914
1952	25,303	6,500	66,462	9,346	75,808	1,665	109,276
1953	38,935	4,295	25,288	3,403	28,691	4,045	75,966
1954	19,237	61,918	7,863	11,518	19,382	3,699	104,235
1955	20,272	66,047	16,218	10,574	26,792	6,474	119,585
1956	25,819	31,550	34,366	22,686	57,051	8,838	123,258
1957	18,392	20,803	37,200	28,143	65,343	5,647	110,185
1958	5,263	92,736	10,009	12,541	22,550	3,383	123,932
1959	3,254	33,733	17,013	17,056	34,069	8,915	79,971
1960	2,295	26,097	33,995	16,696	50,691	1,162	80,244
1961	3,498	19,581	44,274	20,008	64,282	4,666	92,027
1962	1,254	6,969	40,814	22,035	62,849	4,249	75,321
1963	2,073	3,235	43,292	18,254	61,546	5,244	72,098
1964	2,257	5,959	40,684	12,169	52,854	7,454	68,524
1965	2,601	873	30,240	3,198	33,438	8,446	45,357
1966	28,250	398	18,535	2,100	20,635	8,630	57,914
1967	31,575	68	17,319	529	17,848	8,891	58,381
1968	14,096	56	25,251	1,421	26,672	11,309	52,134
1969	61,362	48	24,459	1,070	25,529	9,426	96,365
1970	87,311	201	21,658	282	21,940	11,154	131,478
1971	40,690	135	27,162	71	27,233	14,296	82,355
1972	62,688	169	23,187	49	23,236	9,144	104,332
1973	120,327	69	9,351	26	9,377	5,471	140,689
1974	75,017	6	11,547	61	11,609	13,111	112,816
1975	143,799	2	16,683	130	16,813	10,715	181,915
1976	113,326	24	20,207	298	20,524	9,211	143,065
1977	101,131	5	45,508	5,420	50,928	12,811	164,876
1978	11,437	5	31,258	11,376	42,635	17,145	71,221
1979	48,881	16	16,602	27,643	44,245	19,982	113,123
1980	42,946	34	20,347	29,615	49,962	15,383	108,325
1981	52,308	28	14,218	38,930	53,149	23,510	128,995
1982	42,061	132	26,408	28,372	54,781	16,285	113,259
1983	4,300	352	18,391	32,552	50,943	1,815	57,410
1984	2,956	235	10,676	42,213	52,889	564	56,643
1985	1,626	592	9,360	34,609	43,969	10,275	56,463
1986	1,910	1,164	11,076	41,280	52,356	21,277	76,707
1987	1,447	2,095	11,843	41,631	53,475	19,984	77,000
1988	1,468	3,785	10,323	42,890	53,213	37,231	95,697
1989	2,449	3,908	19,795	36,129	55,924	40,893	103,174
1990	3,201	3,125	4,667	31,794	36,461	28,399	71,186
1991 ^a	3,853	7,750	1,695	30,957	32,652	36,768	81,023

^a Preliminary.

Sources: 1916-68 data from CDFG 1970.

1969 data from CDFG 1986.

1970-89 CPS data and 1970-90 squid data from CDFG 1991a.

1990-91 CPS data from E. Konno, CDFG, Long Beach.

1991 squid data from B. Leos, CDFG, Monterey.

Table 2.1.1-2. West coast Pacific sardine landings (MT), 1916-17 through 1967-68 seasons

Season	British Columbia	Washington	Oregon	California	Baja California	Total
1916-17	0	0	0	24,975	0	24,975
1917-18	73	0	0	65,844	0	65,917
1918-19	3,302	0	0	68,529	0	71,832
1919-20	2,976	0	0	60,809	0	63,785
1920-21	3,992	0	0	34,882	0	38,873
1921-22	898	0	0	33,113	0	34,011
1922-23	925	0	0	59,067	0	59,993
1923-24	880	0	0	76,141	0	77,021
1924-25	1,243	0	0	156,963	0	158,206
1925-26	14,470	0	0	124,531	0	139,000
1926-27	43,999	0	0	138,084	0	182,083
1927-28	62,079	0	0	169,881	0	231,960
1928-29	73,038	0	0	230,863	0	303,901
1929-30	78,327	0	0	294,992	0	373,319
1930-31	68,103	0	0	167,940	0	236,043
1931-32	66,770	0	0	149,365	0	216,134
1932-33	40,234	0	0	227,424	0	267,659
1933-34	3,674	0	0	347,845	0	351,519
1934-35	39,009	0	0	539,829	0	578,839
1935-36	41,114	9	23,796	508,480	0	573,399
1936-37	40,325	5,951	12,882	658,735	0	717,893
1937-38	43,618	15,513	15,114	377,904	0	452,149
1938-39	46,965	24,023	15,440	521,897	0	608,325
1939-40	5,008	16,112	20,258	487,405	0	528,782
1940-41	26,100	735	2,867	417,839	0	447,541
1941-42	54,477	15,513	14,379	532,861	0	617,230
1942-43	59,766	526	1,769	457,825	0	519,887
1943-44	80,504	9,471	1,651	433,756	0	525,382
1944-45	53,633	18	0	503,407	0	557,058
1945-46	31,117	2,096	82	366,219	0	399,513
1946-47	3,620	5,570	3,593	212,104	0	224,886
1947-48	445	1,234	6,287	110,080	0	118,045
1948-49	0	45	4,826	166,675	0	171,547
1949-50	0	0	0	307,471	0	307,471
1950-51	0	0	0	320,319	0	320,319
1951-52	0	0	0	117,122	14,682	131,804
1952-53	0	0	0	5,181	8,312	13,493
1953-54	0	0	0	4,075	12,978	17,053
1954-55	0	0	0	62,111	11,285	73,397
1955-56	0	0	0	67,551	3,817	71,367
1956-57	0	0	0	30,521	12,388	42,908
1957-58	0	0	0	20,205	9,003	29,208
1958-59	0	0	0	94,322	20,261	114,583
1959-60	0	0	0	33,798	19,456	53,254
1960-61	0	0	0	26,198	18,052	44,250
1961-62	0	0	0	23,159	19,296	42,455
1962-63	0	0	0	3,785	13,263	17,048
1963-64	0	0	0	2,669	16,678	19,347
1964-65	0	0	0	5,537	24,603	30,140
1965-66	0	0	0	652	20,182	20,835
1966-67	0	0	0	312	17,718	18,030
1967-68	0	0	0	64	25,090	25,155

Source: Radovich 1981.

Table 2.1.1-3. Recreational harvest of Pacific mackerel and all species in southern California, 1981-1989

Year	Pacific Mackerel		All Species	
	1000's of Fish	Metric Tons	1000's of Fish	Metric Tons
1981	3,029	1,272	14,000	8,729
1982	3,550	1,559	16,405	10,476
1983	3,386	1,347	12,533	8,748
1984	3,450	1,228	14,203	9,937
1985	2,587	1,067	13,812	8,294
1986	2,074	1,002	15,571	9,611
1987	3,402	1,279	13,787	9,734
1988	1,890	829	14,153	7,947
1989	1,669	747	10,569	6,375

Includes fish landed in the round (type A) and fish used for bait, filleted or discarded dead (type B1).

1987-89 estimates are preliminary.

Sources: 1981-86 data from NMFS (1984, 1985a, 1985b, 1987).
1987-89 data from J. Witzig, NMFS, Silver Spring, Maryland.

Table 2.1.1-4. Landings of anchovy and mackerel in Oregon and Washington (MT), 1981-1990

Year	Oregon			Washington		
	Anchovy	Mackerel	Total	Anchovy	Mackerel	Total
1981	0.00	0.01	0.01	1.18	0.00	1.18
1982	0.09	0.04	0.13	5.06	0.00	5.06
1983	0.00	8.28	8.28	2.87	0.00	2.87
1984	0.00	3.05	3.05	10.09	0.00	10.09
1985	0.01	0.01	0.02	11.68	0.00	11.68
1986	0.00	0.00	0.00	22.10	0.00	22.10
1987	0.00	1.46	1.46	77.62	0.00	77.62
1988	0.01	0.64	0.65	35.78	0.00	35.78
1989	0.01	4.74	4.75	61.85	0.00	61.85
1990	0.00	10.24	10.24	50.30	0.14	50.44

Sources: Oregon Department of Fish and Wildlife
Washington Department of Fisheries.

Table 2.1.1-5. Northern anchovy harvest in California, by disposition of catch, and Mexico (MT), 1916-1990

Year	California ^a				Total Mexico	Grand Total
	Reductn	NonRed ^b	Subtotal	LvBait		
1916	---	---	241	0	0	241
1917	---	---	239	0	0	239
1918	---	---	394	0	0	394
1919	---	---	730	0	0	730
1920	---	---	259	0	0	259
1921	---	---	883	0	0	883
1922	---	---	296	0	0	296
1923	---	---	140	0	0	140
1924	---	---	158	0	0	158
1925	---	---	42	0	0	42
1926	---	---	27	0	0	27
1927	---	---	167	0	0	167
1928	---	---	162	0	0	162
1929	---	---	173	0	0	173
1930	---	---	145	0	0	145
1931	---	---	140	0	0	140
1932	---	---	136	0	0	136
1933	---	---	144	0	0	144
1934	---	---	117	0	0	117
1935	---	---	82	0	0	82
1936	---	---	89	0	0	89
1937	---	---	103	0	0	103
1938	---	---	334	0	0	334
1939	---	---	974	1,364	0	2,338
1940	---	---	2,866	1,820	0	4,686
1941	---	---	1,862	1,435	0	3,297
1942	---	---	768	234	0	1,002
1943	---	---	712	0	0	712
1944	---	---	1,765	0	0	1,765
1945	---	---	733	0	0	733
1946	---	---	872	2,493	0	3,365
1947	---	---	8,591	2,589	0	11,180
1948	---	---	4,915	3,379	0	8,294
1949	---	---	1,510	2,542	0	4,052
1950	---	---	2,213	3,469	0	5,682
1951	---	---	3,154	4,665	0	7,819
1952	---	---	25,303	6,178	0	31,481
1953	---	---	38,935	5,798	0	44,733
1954	---	---	19,237	6,066	0	25,303
1955	---	---	20,272	5,557	0	25,829
1956	---	---	25,819	5,744	0	31,563
1957	---	---	18,392	3,729	0	22,121
1958	---	---	5,263	3,843	0	9,106
1959	---	---	3,254	4,297	0	7,551
1960	---	---	2,294	4,225	0	6,519
1961	---	---	3,498	5,364	0	8,862
1962	---	---	1,254	5,595	669	7,518
1963	---	---	2,073	4,030	944	7,047
1964	---	---	2,257	4,709	4,599	11,565

Table 2.1.1-5 (cont.)

Year	California ^a					Total Mexico	Grand Total
	Reductn	NonRed ^b	Subtotal	LvBait	Total		
1965	155	2,446	2,601	5,645	8,246	9,171	17,417
1966	24,810	3,440	28,250	6,144	34,394	13,243	47,637
1967	29,346	2,229	31,575	4,898	36,473	20,104	56,577
1968	12,515	1,581	14,096	6,644	20,740	14,267	35,007
1969	59,153	2,209	61,362	4,891	66,253	3,871	70,124
1970	84,328	2,982	87,310	5,543	92,853	27,977	120,830
1971	39,601	1,089	40,690	5,794	46,484	20,079	66,563
1972	60,435	2,252	62,687	5,307	67,994	30,047	98,041
1973	118,432	1,895	120,327	5,639	125,966	15,424	141,390
1974	73,400	1,640	75,040	5,126	80,166	44,987	125,153
1975	141,586	2,214	143,800	5,577	149,377	56,877	206,254
1976	112,270	1,059	113,327	6,202	119,529	75,746	195,275
1977	99,674	1,457	101,131	6,410	107,541	142,575	250,116
1978	10,339	1,118	11,457	6,013	17,470	140,001	157,471
1979	47,408	5,836	53,244	5,364	58,608	204,585	263,193
1980	43,699	5,338	49,037	4,921	56,234	245,797	302,031
1981	51,290	246	51,536	4,698	56,234	258,700	314,934
1982	43,742	1,117	44,859	6,978	51,837	177,587	229,424
1983	2,854	1,446	4,300	4,187	8,487	79,389	87,876
1984	1,722	1,183	2,905	4,397	7,302	101,118	108,420
1985	825	1,184	2,009	3,775	5,784	121,081	126,865
1986	546	1,002	1,548	3,956	5,504	96,417	101,921
1987	149	1,154	1,303	3,572	4,875	124,475	129,350
1988	234	1,234	1,468	4,188	5,656	79,230	84,886
1989	109	2,341	2,450	4,594	7,044	80,823	87,867
1990	63	3,145	3,208	4,841	8,049	99	8,148
1991 ^c	1,045	2,808	3,853	5,039	8,892	831	9,723

Table 2.1.1-5 (cont.)

^a Separate statistics on reduction and nonreduction landings in California are available beginning in 1965, when a separate reduction quota was first established.

^b Includes anchovy used for canning, consumption as fresh fish, freezing and dead bait.

^c Preliminary.

Sources: 1962-74 Mexican landings from Chavez 1977.
 1975-88 Mexican landings from L. Jacobson, NMFS, SWFSC, La Jolla, California.
 1916-64 California reduction landings and 1939-64 live bait catches from Tables 3.2-2 and 3.2-3 in PFMC 1983.
 1965-90 California reduction, nonreduction and live bait catches from Thomson et al. 1991 and previous issues of the same report.
 1991 California landings from E. Konno, CDFG, Long Beach.

Table 2.1.1-6. California landings of market squid (MT), 1970-90

Year	Monterey	Southern California	Other	Statewide Total
-----	-----	-----	-----	-----
1970	3,914	7,241	0	11,155
1971	7,551	6,745	0	14,296
1972	5,560	3,583	0	9,144
1973	562	4,908	0	5,470
1974	6,575	6,536	0	13,112
1975	2,263	8,451	0	10,715
1976	2,278	6,933	0	9,211
1977	2,027	10,784	0	12,810
1978	9,370	7,776	0	17,145
1979	12,867	7,114	1	19,982
1980	7,127	8,255	1	15,383
1981	12,822	10,686	2	23,510
1982	10,587	5,694	5	16,285
1983	492	862	462	1,815
1984	391	76	97	564
1985	3,812	6,386	77	10,275
1986	5,488	14,958	832	21,277
1987	4,780	14,861	343	19,984
1988	4,834	31,420	386	36,641
1989	7,146	33,743	4	40,893
1990	7,902	20,367	130	28,399
1991 ^a	6,703	28,591	1,473	36,767

^a Preliminary.

Sources: 1970-90 data from CDFG 1991a.
1991 data from B. Leos, CDFG, Monterey.

Table 2.1.2-1. Total Washington, Oregon and California landings (MT) of northern anchovy, Pacific and jack mackerel, Pacific sardine and market squid, by gear type, 1981-1990

Line	Northern Anchovy							Year	RndHaul ^a
	Pot/Trap	Dip Net	Trawl	Gill Net	Other/Unk	Total			
1981	52,202.4	22.3	0.1	0.0	0.0	---	25.0	52,250.0	
1982	41,735.3	7.0	0.0	0.1	0.0	0.3	412.7	42,155.4	
1983	1,615.2	0.0	0.0	0.0	0.0	---	2,814.0	4,429.2	
1984	2,088.4	---	0.0	0.0	0.0	0.1	829.1	2,917.6	
1985	1,205.2	0.1	0.0	0.0	0.0	0.0	432.2	1,637.5	
1986	1,110.8	---	0.0	---	0.0	0.0	440.9	1,551.8	
1987	1,301.6	0.3	0.0	0.2	---	0.0	165.3	1,467.3	
1988	1,292.9	0.1	0.3	0.3	---	0.0	224.6	1,518.2	
1989	2,264.8	---	0.2	0.0	0.0	0.0	245.3	2,510.3	
1990	2,671.2	23.5	0.2	0.1	0.0	0.0	563.7	3,258.5	
Pacific and Jack Mackerel									
1981	52,970.1	41.7	0.2	9.1	5.8	79.7	46.7	53,153.3	
1982	54,728.5	33.2	0.3	44.7	6.3	57.4	771.6	55,642.0	
1983	39,029.4	25.3	0.2	0.0	5.8	25.8	12,214.7	51,301.1	
1984	45,524.8	144.1	0.0	3.6	2.8	127.0	6,822.6	52,624.9	
1985	42,126.1	80.0	0.1	4.3	5.1	77.5	2,233.9	44,527.1	
1986	47,723.8	64.7	0.9	21.0	0.2	0.9	4,958.5	52,770.0	
1987	47,844.0	27.0	1.0	0.0	1.2	0.1	6,850.1	54,723.3	
1988	54,074.3	95.3	1.3	0.2	35.3	0.1	1,665.6	55,872.0	
1989	55,425.5	47.8	0.1	8.3	4.7	0.0	2,982.3	58,468.8	
1990	40,603.2	61.7	0.2	0.1	12.7	0.0	2,473.1	43,151.0	
Pacific Sardine									
1981	14.8	0.0	0.0	0.0	0.0	---	0.0	14.8	
1982	1.8	0.0	0.0	0.0	0.0	0.0	0.0	1.8	
1983	0.6	0.0	0.0	0.0	0.0	0.0	---	0.6	
1984	0.5	0.0	0.0	0.0	0.0	---	0.5	1.0	
1985	4.8	0.0	0.0	0.1	0.0	0.0	1.0	5.8	
1986	323.9	0.0	0.0	4.0	0.0	---	60.5	388.4	
1987	352.8	0.0	0.0	0.0	0.0	0.0	86.5	439.3	
1988	1,094.3	0.0	0.0	0.0	0.0	0.0	52.0	1,146.2	
1989	739.9	---	0.0	0.0	0.0	0.0	6.8	746.8	
1990	1,559.2	0.1	0.0	0.1	0.0	0.0	61.1	1,620.4	
Market Squid									
Year	RndHaul ^a	Line	Pot/Trap	Dip Net	Trawl	Gill Net	Oth/Unk	Total	
1981	15,268.9	9.9	0.0	8,080.1	6.2	0.4	4.6	23,370.0	
1982	12,487.9	57.2	0.3	3,579.1	6.5	10.9	183.5	16,325.3	
1983	837.6	0.9	0.2	515.0	2.1	1.2	641.3	1,998.3	
1984	537.3	0.1	0.3	73.1	3.0	0.4	391.7	1,006.0	
1985	7,924.1	29.1	0.5	492.3	15.7	201.9	2,249.7	10,913.4	
1986	16,890.6	26.8	5.1	54.2	6.1	0.0	4,305.0	21,287.7	
1987	16,590.1	28.3	0.9	213.8	7.8	0.0	3,143.4	19,984.2	
1988	31,057.7	515.4	0.1	137.3	6.2	0.0	5,513.4	37,230.1	
1989	35,587.3	499.4	0.6	221.6	127.0	0.0	4,500.9	40,936.7	
1990	25,846.1	50.1	1.4	0.1	2.2	0.0	2,541.8	28,441.7	

^a Includes unspecified net gears as well as round haul gear.

--- Denotes trace amount.

Source: WOC fish ticket data converted to PacFIN format.

Table 2.1.2-2. Number of California, Oregon, Washington and joint-vent vessels landing CPS or squid, by principal gear^a, 1981-1990

Principal Gear/Year	CPS>0, Squid=0					CPS>0,Squid>0				CPS=0,Squid>0					G T
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	JV	Sum	
Round Haul: ^b															
1981	41	0	2	0	43	50	0	1	51	10	0	3	0	13	
1982	51	0	0	0	51	53	0	0	53	8	0	0	0	8	
1983	53	0	1	0	54	22	1	0	23	5	1	1	0	7	
1984	96	0	1	0	97	8	1	0	9	1	4	0	0	5	
1985	126	0	2	0	128	48	0	0	48	11	6	1	0	18	
1986	105	0	2	0	107	50	0	0	50	8	1	0	0	9	
1987	104	0	2	0	106	51	0	0	51	11	0	0	0	11	
1988	82	0	2	0	84	49	0	0	49	25	0	0	0	25	
1989	80	0	2	0	82	47	0	0	47	17	0	0	0	17	
1990	81	0	2	0	83	52	0	0	52	15	0	0	0	15	
Line:															
1981	80	0	0	0	80	4	0	0	4	6	0	0	0	6	
1982	76	1	0	0	77	2	0	0	2	5	0	0	0	5	
1983	33	3	0	0	36	2	0	0	2	1	0	1	0	2	
1984	37	0	0	0	37	0	1	0	1	6	0	0	0	6	
1985	40	0	0	0	40	3	0	0	3	5	1	0	0	6	
1986	22	0	0	0	22	1	0	0	1	4	0	0	0	4	
1987	32	3	0	0	35	1	0	0	1	2	0	0	0	2	
1988	38	4	1	0	43	2	0	0	2	5	0	0	0	5	
1989	64	20	0	0	84	0	0	0	0	1	0	0	0	1	
1990	73	64	5	0	142	2	0	0	2	5	0	0	0	5	
Pot/Trap:															
1981	8	0	0	0	8	0	0	0	0	2	0	0	0	2	
1982	4	0	0	0	4	0	0	0	0	2	0	0	0	2	
1983	5	0	0	0	5	0	0	0	0	5	1	0	0	6	
1984	8	0	0	0	8	1	0	0	1	3	0	1	0	4	
1985	8	0	0	0	8	0	0	0	0	2	3	0	0	5	
1986	7	0	0	0	7	1	0	0	1	1	0	0	0	1	
1987	12	0	0	0	12	1	0	0	1	5	0	0	0	5	
1988	5	0	0	0	5	3	0	0	3	1	0	0	0	1	
1989	10	1	0	0	11	0	0	0	0	3	0	0	0	3	
1990	8	3	0	0	11	2	0	0	2	1	0	0	0	1	
Trawl:															
1981	4	1	0	0	5	8	0	0	8	8	1	5	0	14	
1982	10	0	0	0	10	3	0	0	3	12	3	5	0	20	
1983	13	6	0	0	19	1	0	0	1	8	7	2	0	17	
1984	5	1	0	0	6	2	0	0	2	2	6	3	0	11	
1985	2	0	0	1	3	4	1	0	5	2	2	4	1	9	
1986	1	0	0	0	1	2	0	0	2	3	2	12	0	17	
1987	1	1	0	0	2	3	0	0	3	7	0	11	0	18	
1988	2	1	0	0	3	2	0	0	2	2	0	8	0	10	
1989	8	1	0	0	9	0	0	0	0	2	2	2	0	6	
1990	6	2	0	3	11	1	0	0	1	7	1	1	0	9	

Principal Year/Year	CPS>0, Squid=0					CPS>0, Squid>0				CPS=0, Squid>0					Grand Total
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	JV	Sum	
p Net:															
1981	0	0	0	0	0	4	0	0	4	35	0	2	0	37	41
1982	1	0	0	0	1	4	0	0	4	26	0	1	0	27	32
1983	0	0	0	0	0	1	0	0	1	11	0	6	0	17	18
1984	0	0	0	0	0	0	0	0	0	1	0	6	0	7	7
1985	0	0	0	0	0	1	0	0	1	14	0	0	0	14	15
1986	1	0	0	0	1	0	0	0	0	6	0	1	0	7	8
1987	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4
1988	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3
1989	0	0	0	0	0	1	0	0	1	1	0	0	0	1	2
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ll Net:															
1981	48	0	0	0	48	6	0	0	6	5	0	0	0	5	59
1982	46	0	1	0	47	1	0	0	1	3	0	0	0	3	51
1983	48	0	0	0	48	4	0	0	4	14	0	1	0	15	67
1984	13	0	0	0	13	1	0	0	1	0	0	0	0	0	14
1985	3	0	0	0	3	0	0	0	0	0	0	0	0	0	3
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ner/Unknown:															
1981	8	0	0	0	8	0	0	0	0	3	0	1	0	4	12
1982	12	0	0	0	12	0	0	0	0	3	0	3	0	6	18
1983	41	0	1	0	42	11	0	0	11	12	0	7	0	19	72
1984	78	0	1	0	79	17	0	0	17	11	0	4	0	15	111
1985	36	0	1	0	37	14	0	0	14	12	0	2	0	14	65
1986	26	0	0	0	26	11	0	0	11	14	1	3	0	18	55
1987	12	0	0	0	12	5	0	0	5	9	0	2	0	11	28
1988	7	0	1	0	8	10	0	0	10	18	0	0	0	18	36
1989	12	0	0	0	12	7	0	0	7	11	0	0	0	11	30
1990	10	0	0	0	10	5	0	0	5	5	0	0	0	5	20
L GEARS:															
1981	189	1	2	0	192	72	0	1	73	69	1	11	0	81	346
1982	200	1	1	0	202	63	0	0	63	59	3	9	0	71	336
1983	193	9	2	0	204	41	1	0	42	56	9	18	0	83	329
1984	237	1	2	0	240	29	2	0	31	24	10	14	0	48	319
1985	215	0	3	1	219	70	1	0	71	46	12	7	1	66	356
1986	162	0	2	0	164	65	0	0	65	36	4	16	0	56	285
1987	161	4	2	0	167	61	0	0	61	38	0	13	0	51	279
1988	135	5	4	0	144	66	0	0	66	54	0	8	0	62	272
1989	174	22	2	0	198	55	0	0	55	35	2	2	0	39	292
1990	178	69	7	3	257	62	0	0	62	33	1	1	0	35	354

Principal gear is the gear with which a vessel made most of its landings during the year.

Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-3. Number of California, Oregon, Washington and joint-venture vessels landing CPS or squid, by landings category, 1981-1990

Year	Round Haul Vessels ^a															Grand Total					
	Non-Round Haulers					CPS=0					0<CPS<50										
	CPS+Squid<50					Squid≥50 ^b					CPS+Squid≥50 ^b						CPS≥50 ^c				
	CA OR WA JV Sum					CA OR WA Sum					CA OR WA Sum						CA WA Sum				
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	Sum	CA	OR		WA	Sum	CA	WA	Sum
1981	229	2	8	0	239	22	0	6	28	5	0	5	5	16	0	16	58	0	58	346	
1982	210	4	10	0	224	26	0	0	26	4	0	4	4	26	0	26	56	0	56	336	
1983	210	17	18	0	245	24	1	2	27	1	0	1	1	2	1	3	53	0	53	329	
1984	185	8	15	0	208	58	2	1	61	0	2	2	1	0	1	1	47	0	47	319	
1985	146	7	7	2	162	124	3	3	130	3	3	6	6	13	0	13	45	0	45	356	
1986	100	3	16	0	119	105	1	2	108	2	0	2	2	9	0	9	47	0	47	285	
1987	94	4	13	0	111	104	0	1	105	4	0	4	4	9	0	9	49	1	50	279	
1988	99	5	10	0	114	88	0	2	90	18	0	18	18	7	0	7	43	0	43	272	
1989	120	24	2	0	146	82	0	2	84	11	0	11	11	6	0	6	45	0	45	292	
1990	125	70	6	3	204	91	0	2	93	5	0	5	5	6	0	6	46	0	46	354	

^a Includes vessels whose principal gear is round haul or an unspecified net gear.

^b No Washington boats in this category in any year.

^c No Oregon boats in this category in any year.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-4. Total number of vessels landing CPS or squid in Washington, Oregon and California and percent distribution of vessels across landing categories, 1981-1990

Year	Total # Vessels	Non-Round Haulers	Round Haul Vessels ^a			
			CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50
1981	346	69.1%	8.1%	1.4%	4.6%	16.8%
1982	336	66.7%	7.7%	1.2%	7.7%	16.7%
1983	329	74.5%	8.2%	0.3%	0.9%	16.1%
1984	319	65.3%	19.1%	0.6%	0.3%	14.7%
1985	356	45.5%	36.5%	1.7%	3.7%	12.6%
1986	285	41.7%	37.9%	0.7%	3.2%	16.5%
1987	279	39.9%	37.6%	1.4%	3.2%	17.9%
1988	272	41.8%	33.1%	6.7%	2.6%	15.8%
1989	292	49.9%	28.8%	3.8%	2.1%	15.4%
1990	354	57.6%	26.3%	1.4%	1.7%	13.0%

Year	Total CPS Landings	Non-Round Haulers	Round Haul Vessels ^a			
			CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50
1981	105,418.1	0.1%	0.2%	0.0%	0.1%	99.6%
1982	97,799.2	0.1%	0.2%	0.0%	0.3%	99.4%
1983	55,730.9	18.2%	0.6%	0.0%	0.1%	81.1%
1984	55,543.5	10.5%	0.6%	0.0%	---	88.9%
1985	46,170.4	1.8%	0.7%	0.0%	0.3%	97.2%
1986	54,710.2	1.8%	0.4%	0.0%	0.2%	97.6%
1987	56,629.9	1.4%	0.3%	0.0%	0.2%	98.1%
1988	58,536.4	1.0%	0.4%	0.0%	0.1%	98.5%
1989	61,725.9	3.7%	0.5%	0.0%	0.1%	95.7%
1990	48,029.9	3.2%	0.7%	0.0%	0.2%	95.9%

Year	Total Squid Landings	Non-Round Haulers	Round Haul Vessels ^a			
			CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50
1981	23,370.0	31.3%	0.6%	5.9%	28.5%	33.7%
1982	16,325.3	22.2%	0.7%	4.7%	45.8%	26.6%
1983	1,998.3	54.1%	5.8%	7.6%	6.2%	26.3%
1984	1,006.0	48.1%	5.5%	17.5%	13.3%	15.6%
1985	10,913.4	16.6%	2.1%	8.0%	16.7%	56.6%
1986	21,287.7	7.5%	0.4%	2.1%	11.9%	78.1%
1987	19,984.2	8.8%	0.6%	7.6%	15.4%	67.6%
1988	37,230.1	9.3%	0.6%	20.5%	3.0%	66.6%
1989	40,936.7	7.4%	0.5%	29.1%	6.4%	56.6%
1990	28,441.7	4.2%	0.5%	14.9%	10.4%	70.0%

Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-5. Number of Washington, Oregon and California round haul vessels landing any CPS or squid, by vessel length, 1981-1990

Fishing Year/ Vessel Length	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
-----	-----	-----	-----	-----	-----
1981:					
11-20'	5	0	0	0	5
21-30'	8	0	1	0	9
31-40'	11	1	7	6	25
41-50'	3	4	8	18	33
51-60'	1	0	0	7	8
61-70'	0	0	0	12	12
71-80'	0	0	0	13	13
>80'	0	0	0	2	2
Total	28	5	16	58	107
1982:					
11-20'	3	0	0	0	3
21-30'	8	0	1	0	9
31-40'	8	2	11	6	27
41-50'	4	0	14	16	36
51-60'	1	0	0	7	8
61-70'	1	0	0	12	13
71-80'	0	0	0	14	14
>80'	0	0	0	1	1
Unknown	1	0	0	0	1
Total	26	2	26	56	112
1983:					
11-20'	0	0	0	0	0
21-30'	1	0	0	0	1
31-40'	11	0	1	7	19
41-50'	9	1	2	13	25
51-60'	5	0	0	7	12
61-70'	0	0	0	13	13
71-80'	0	0	0	12	12
>80'	1	0	0	1	2
Total	27	1	3	53	84
1984:					
11-20'	4	0	0	0	4
21-30'	20	0	0	0	20
31-40'	24	1	0	4	29
41-50'	9	1	0	14	24
51-60'	4	0	1	5	10
61-70'	0	0	0	11	11
71-80'	0	0	0	12	12
>80'	0	0	0	1	1
Total	61	2	1	47	111
1985:					
11-20'	8	0	0	0	8
21-30'	48	0	0	1	49
31-40'	54	0	4	3	61
41-50'	16	2	9	12	39
51-60'	3	3	0	7	13
61-70'	0	1	0	10	11
71-80'	1	0	0	11	12
>80'	0	0	0	1	1
Total	130	6	13	45	194

ble 2.1.2-5 (cont.)

Shing Year/ essel Length	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
-----	-----	-----	-----	-----	-----
36:					
1-20'	5	0	0	0	5
1-30'	44	0	0	1	45
1-40'	45	0	1	5	51
1-50'	8	1	7	12	28
1-60'	4	0	1	9	14
1-70'	0	1	0	9	10
1-80'	2	0	0	10	12
30'	0	0	0	1	1
total	108	2	9	47	166
37:					
1-20'	2	0	0	0	2
1-30'	39	0	1	2	42
1-40'	47	0	2	2	51
1-50'	12	3	5	15	35
1-60'	3	1	1	10	15
1-70'	2	0	0	10	12
1-80'	0	0	0	10	10
30'	0	0	0	1	1
total	105	4	9	50	168
38:					
1-20'	2	0	0	0	2
1-30'	31	1	1	1	34
1-40'	36	3	3	1	43
1-50'	17	10	2	13	42
1-60'	4	2	1	10	17
1-70'	0	1	0	7	8
1-80'	0	1	0	10	11
30'	0	0	0	1	1
total	90	18	7	43	158
39:					
1-20'	5	0	0	0	5
1-30'	26	0	0	1	27
1-40'	38	1	1	6	46
1-50'	9	6	4	10	29
1-60'	5	2	1	10	18
1-70'	1	1	0	8	10
1-80'	0	1	0	9	10
30'	0	0	0	1	1
total	84	11	6	45	146
90:					
1-20'	3	0	0	0	3
1-30'	30	0	0	0	30
1-40'	38	0	0	4	42
1-50'	14	3	5	12	34
1-60'	6	2	1	9	18
1-70'	2	0	0	8	10
1-80'	0	0	0	12	12
30'	0	0	0	1	1
total	93	5	6	46	150

essels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-6. Number of Washington, Oregon and California round haul vessels landing CPS or squid, by year built, 1981-1990

Fishing Year & Year Built	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
-----	-----	-----	-----	-----	-----
1981:					
<1930	1	0	2	1	4
1931-1940	0	0	3	16	19
1941-1950	2	0	5	17	24
1951-1960	3	1	0	4	8
1961-1970	2	2	0	6	10
1971-1980	6	2	4	12	24
1981-1990	0	0	0	0	0
Unknown	14	0	2	2	18
Total	28	5	16	58	107
1982:					
<1930	1	0	2	2	5
1931-1940	1	1	2	16	20
1941-1950	3	2	8	13	26
1951-1960	4	0	2	3	9
1961-1970	1	1	2	7	11
1971-1980	3	0	8	13	24
1981-1990	1	0	1	2	4
Unknown	12	0	1	0	13
Total	26	4	26	56	112
1983:					
<1930	1	0	0	1	2
1931-1940	1	0	1	15	17
1941-1950	5	0	0	16	21
1951-1960	4	0	0	2	6
1961-1970	4	1	0	4	9
1971-1980	7	0	2	7	16
1981-1990	2	0	0	3	5
Unknown	3	0	0	5	8
Total	27	1	3	53	84
1984:					
<1930	3	0	0	1	4
1931-1940	0	0	0	15	15
1941-1950	7	0	0	13	20
1951-1960	4	0	0	2	6
1961-1970	7	0	0	1	8
1971-1980	18	2	1	10	31
1981-1990	2	0	0	2	4
Unknown	20	0	0	3	23
Total	61	2	1	47	111
1985:					
<1930	3	0	0	1	4
1931-1940	2	0	1	13	16
1941-1950	11	0	3	12	26
1951-1960	11	1	0	1	13
1961-1970	12	0	1	2	15
1971-1980	30	4	5	11	50
1981-1990	1	0	1	1	3
Unknown	60	1	2	4	67
Total	130	6	13	45	194

Table 2.1.2-6 (cont.)

Shipping Year Year Built	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
-----	-----	-----	-----	-----	-----
86:					
1930	3	0	0	1	4
1931-1940	0	0	0	12	12
1941-1950	9	0	2	12	23
1951-1960	9	1	0	2	12
1961-1970	6	0	1	3	10
1971-1980	23	1	6	11	41
1981-1990	0	0	0	1	1
unknown	58	0	0	5	63
total	108	2	9	47	166
87:					
1930	5	0	0	1	6
1931-1940	1	0	0	12	13
1941-1950	8	0	3	9	20
1951-1960	7	0	0	1	8
1961-1970	5	0	0	3	8
1971-1980	25	3	5	14	47
1981-1990	0	0	0	2	2
unknown	54	1	1	8	64
total	105	4	9	50	168
88:					
1930	0	0	0	1	1
1931-1940	3	1	0	8	12
1941-1950	5	4	2	8	19
1951-1960	5	0	0	1	6
1961-1970	10	0	0	2	12
1971-1980	26	10	1	12	49
1981-1990	3	1	1	9	14
unknown	38	2	3	2	45
total	90	18	7	43	158
89:					
1930	0	0	0	1	1
1931-1940	2	1	1	8	12
1941-1950	5	3	0	9	17
1951-1960	8	0	0	1	9
1961-1970	8	0	1	2	11
1971-1980	15	6	4	9	34
1981-1990	3	1	0	12	16
unknown	43	0	0	3	46
total	84	11	6	45	146
90:					
1930	0	0	0	1	1
1931-1940	1	0	0	10	11
1941-1950	6	0	1	11	18
1951-1960	9	0	0	0	9
1961-1970	9	0	0	1	10
1971-1980	22	4	4	10	40
1981-1990	8	1	1	11	21
unknown	38	0	0	2	40
total	93	5	6	46	150

Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-7. Number of Washington, Oregon and California round haul vessels landing CPS or squid, by principal fishing area, 1981-1990

Year and Principal Fishing Area	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
-----	-----	-----	-----	-----	-----
1981:					
San Diego	1	0	0	0	1
Orange/LA	5	2	0	40	47
Vent/SBarb	2	0	0	5	7
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	13	3	16	11	43
SanFran Bay Area	0	0	0	2	2
Oregon	0	0	0	0	0
Washington	6	0	0	0	6
Total	28	5	16	58	107
1982:					
San Diego	1	0	0	0	1
Orange/LA	8	0	0	42	50
Vent/SBarb	2	1	0	6	9
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	11	3	26	7	47
SanFran Bay Area	2	0	0	1	3
Oregon	0	0	0	0	0
Washington	0	0	0	0	0
Total	26	4	26	56	112
1983:					
San Diego	1	0	0	0	1
Orange/LA	10	0	0	42	52
Vent/SBarb	4	0	0	1	5
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	3	1	0	8	12
SanFran Bay Area	6	0	2	2	10
Oregon	1	0	1	0	2
Washington	2	0	0	0	2
Total	27	1	3	53	84
1984:					
San Diego	15	0	0	0	15
Orange/LA	28	0	0	37	65
Vent/SBarb	13	0	0	1	14
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	0	0	0	9	9
SanFran Bay Area	0	0	0	0	0
Oregon	2	2	1	0	5
Washington	1	0	0	0	1
Total	61	2	1	47	111
1985:					
San Diego	17	0	0	0	17
Orange/LA	48	1	0	33	82
Vent/SBarb	19	1	0	4	24
SanLuisObispo	6	0	0	0	6
Monterey/StaCruz	23	0	13	8	44
SanFran Bay Area	11	1	0	0	12
Oregon	3	3	0	0	6
Washington	3	0	0	0	3
Total	130	6	13	45	194

Gear and Principal Fishing Area	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50	Total
1986:					
San Diego	16	0	0	0	16
Orange/LA	34	0	1	32	67
Vent/SBarb	14	1	0	7	22
SanLuisObispo	4	0	0	0	4
Monterey/StaCruz	17	1	7	8	33
SanFran Bay Area	20	0	1	0	21
Oregon	1	0	0	0	1
Washington	2	0	0	0	2
Total	108	2	9	47	166
1987:					
San Diego	12	0	0	0	12
Orange/LA	34	0	1	35	70
Vent/SBarb	20	2	2	7	31
SanLuisObispo	3	0	0	0	3
Monterey/StaCruz	14	2	5	6	27
SanFran Bay Area	21	0	1	1	23
Oregon	0	0	0	0	0
Washington	1	0	0	1	2
Total	105	4	9	50	168
1988:					
San Diego	13	0	0	0	13
Orange/LA	40	2	0	31	73
Vent/SBarb	13	9	2	8	32
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	9	6	5	3	23
SanFran Bay Area	12	1	0	1	14
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	90	18	7	43	158
1989:					
San Diego	12	0	0	0	12
Orange/LA	37	1	0	31	69
Vent/SBarb	10	5	1	7	23
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	9	5	5	6	25
SanFran Bay Area	13	0	0	1	14
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	84	11	6	45	146
1990:					
San Diego	17	0	0	0	17
Orange/LA	35	0	0	28	63
Vent/SBarb	11	1	2	6	20
SanLuisObispo	3	0	0	0	3
Monterey/StaCruz	13	4	4	11	32
SanFran Bay Area	12	0	0	1	13
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	93	5	6	46	150

Principal fishing area is the area in which the vessel made most of its landings during the year.

Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data in PacFIN format.

Table 2.1.2-8. Average number of trips made by Washington, Oregon and California round haul vessels^a landing CPS or squid, and proportion of trips including CPS or squid, 1981-1990

Year	CPS+Squid<50				CPS=0, Squid≥50			
	#Trips	%CPS	%Squid	%CPS-Sqd	# Trips	%CPS	%Squid	%CPS-Sqd
1981	18.8	27.1%	17.1%	43.0%	53.0	0.0%	87.2%	87.2%
1982	23.2	19.1%	9.3%	27.9%	49.0	0.0%	72.4%	72.4%
1983	24.0	32.5%	9.9%	42.1%	102.0	0.0%	12.7%	12.7%
1984	63.7	13.0%	0.2%	13.2%	35.0	0.0%	41.4%	41.4%
1985	59.1	14.9%	1.0%	15.8%	40.2	0.0%	33.2%	33.2%
1986	64.5	13.9%	0.9%	14.7%	63.5	0.0%	45.7%	45.7%
1987	54.7	12.3%	1.4%	13.6%	37.3	0.0%	67.1%	67.1%
1988	54.5	14.0%	1.0%	14.9%	38.6	0.0%	66.2%	66.2%
1989	56.9	17.7%	0.9%	18.6%	57.1	0.0%	82.3%	82.3%
1990	52.9	20.6%	1.0%	21.5%	67.4	0.0%	88.4%	88.4%

Year	0<CPS<50, CPS+Squid≥50				CPS≥50			
	#Trips	%CPS	%Squid	%CPS-Sqd	# Trips	%CPS	%Squid	%CPS-Sqd
1981	88.4	3.5%	84.1%	86.4%	83.3	70.1%	17.8%	88.0%
1982	67.8	6.8%	78.2%	82.0%	74.0	84.5%	9.6%	93.3%
1983	46.7	16.4%	26.4%	41.4%	51.8	80.0%	3.2%	82.6%
1984	48.0	2.1%	41.7%	43.8%	50.3	78.1%	2.5%	80.4%
1985	46.9	6.1%	57.5%	60.6%	51.8	70.0%	17.6%	86.0%
1986	62.8	14.0%	66.4%	77.7%	66.0	61.8%	29.1%	88.4%
1987	61.7	8.1%	63.0%	68.8%	65.2	67.2%	20.2%	86.7%
1988	51.7	7.5%	55.3%	59.1%	75.6	58.5%	31.9%	88.7%
1989	66.7	3.8%	72.0%	74.5%	75.3	61.5%	27.7%	87.1%
1990	36.8	5.0%	69.2%	72.4%	63.3	58.3%	29.2%	86.3%

%CPS and %Squid do not necessarily sum to the percentage of trips on which CPS or squid were landed (%CPS-Sqd), since both CPS and squid are sometimes (though infrequently) landed on a single trip.

^a Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data converted to Pacific format.

Table 2.1.2-9. Average landings (MT) by Washington, Oregon and California round haul vessels^a landing CPS or squid, by species, 1981-1990

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All	Else	Total
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
CPS+Squid < 50 MT:										
1981	3.1	2.7	0.0	4.8	4.6	0.1	---	1.0		16.3
1982	2.5	3.8	---	4.1	1.8	0.2	0.9	1.9		15.2
1983	3.4	8.7	0.0	4.3	18.9	0.3	0.4	5.4		41.4
1984	3.2	2.2	0.0	0.9	0.7	0.2	1.1	8.6		16.9
1985	1.2	1.4	0.0	1.8	1.2	0.2	0.8	16.2		22.8
1986	0.9	1.2	---	0.8	2.1	0.3	0.1	15.8		21.2
1987	0.9	0.8	---	1.1	1.5	0.5	0.2	13.6		18.6
1988	1.2	1.6	0.1	2.3	2.3	0.4	0.6	11.0		19.5
1989	3.1	0.8	---	2.4	1.9	0.1	0.1	9.3		17.7
1990	2.2	1.4	---	1.6	2.3	0.4	0.2	10.1		18.2
CPS=0, Squid≥50 MT:										
1981	0.0	0.0	0.0	275.6	9.8	0.0	16.4	2.2		304.0
1982	0.0	0.0	0.0	192.4	10.2	0.0	5.9	15.4		223.9
1983	0.0	0.0	0.0	151.9	0.0	0.0	1.8	2.7		156.4
1984	0.0	0.0	0.0	87.2	21.0	0.0	0.8	34.4		143.4
1985	0.0	0.0	0.0	144.8	10.4	---	6.1	68.7		230.0
1986	0.0	0.0	0.0	227.1	13.8	0.0	0.1	11.9		252.9
1987	0.0	0.0	0.0	381.6	32.9	5.4	0.0	13.5		433.4
1988	0.0	0.0	0.0	423.3	26.4	0.0	2.7	13.5		465.9
1989	0.0	0.0	0.0	1,081.7	41.5	0.0	5.8	7.4		1,136.4
1990	0.0	0.0	0.0	848.3	36.0	0.0	0.0	1.0		885.3
0<CPS<50 MT, CPS+Squid≥50 MT:										
1981	0.1	7.6	0.0	416.9	29.4	0.0	1.6	5.0		460.6
1982	0.6	10.3	0.0	287.5	40.6	0.0	---	7.0		346.0
1983	6.2	15.9	0.0	41.6	49.4	---	0.9	14.6		128.6
1984	0.3	0.0	0.0	133.5	0.0	0.0	7.0	57.8		198.6
1985	3.0	5.9	0.0	140.6	34.5	0.0	0.3	12.9		197.2
1986	6.8	5.8	0.3	280.6	27.2	0.0	0.0	10.6		331.3
1987	1.1	10.6	0.3	341.5	42.4	0.1	0.0	10.8		406.8
1988	1.8	10.2	0.4	157.0	33.0	0.0	0.1	3.6		206.1
1989	6.6	8.4	0.0	439.9	32.3	---	0.5	4.3		492.0
1990	0.0	19.5	0.2	491.7	0.0	0.9	3.6	12.9		528.8

Table 2.1.2-9 (cont.)

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS≥50 MT:									
1981	899.4	909.8	0.3	135.9	12.6	94.1	33.9	1.6	2,087.6
1982	751.2	984.7	---	77.5	15.1	43.0	29.5	2.4	1,903.4
1983	21.7	831.2	---	9.9	11.9	61.8	43.5	3.2	983.2
1984	43.8	1,006.3	---	3.3	5.5	55.4	94.9	9.4	1,218.6
1985	26.1	970.8	0.1	137.3	9.3	60.8	43.1	2.6	1,249.3
1986	19.7	1,109.8	7.0	354.0	8.8	4.3	82.5	2.0	1,587.2
1987	25.6	1,078.0	7.7	270.2	10.4	85.7	27.4	4.5	1,509.7
1988	30.4	1,284.5	26.1	576.5	10.2	89.9	33.4	4.4	2,054.2
1989	47.0	1,249.5	15.6	514.5	12.1	22.1	22.7	3.1	1,886.7
1990	64.6	901.9	35.1	432.9	18.6	85.1	30.6	3.2	1,570.3
All Round Haul Vessels:									
1981	488.3	495.0	0.1	150.1	12.9	51.0	19.4	2.1	1,218.9
1982	376.3	495.6	---	113.3	17.8	21.5	15.2	3.8	1,043.5
1983	15.0	527.8	---	10.9	15.4	39.1	27.6	4.3	640.1
1984	20.3	427.3	---	4.7	3.1	23.5	40.8	10.0	529.7
1985	7.0	226.5	---	46.9	5.6	14.2	10.8	14.4	325.4
1986	6.5	313.4	2.0	118.0	5.5	1.4	23.3	11.2	481.3
1987	8.3	321.9	2.3	108.5	7.1	25.9	8.3	10.8	493.1
1988	9.0	350.9	7.1	213.4	8.6	24.7	9.7	8.9	632.3
1989	16.5	385.9	4.8	259.5	9.3	6.9	7.5	7.1	697.5
1990	21.2	278.2	10.8	181.7	8.3	26.4	9.6	7.3	543.5

^a Vessels whose principal gear is round haul or an unspecified net gear.

--- Denotes trace amount.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-10. Average ex-vessel revenues (\$1000's; base year=1989) by Washington, Oregon and California round haul vessels^a landing any CPS or squid, by species, 1981-1990

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS+Squid < 50 MT:									
1981	1.1	0.9	0.0	2.1	3.6	0.1	---	2.4	10.2
1982	0.9	1.0	0.0	2.6	2.7	0.1	2.5	4.4	14.2
1983	1.3	2.0	0.0	2.5	25.6	0.4	0.7	15.7	48.2
1984	1.1	0.8	0.0	0.3	0.2	0.1	1.9	30.0	34.4
1985	0.5	0.7	0.0	0.9	3.2	0.1	1.3	32.5	39.2
1986	0.5	0.3	0.0	0.2	1.0	0.2	0.3	32.7	35.2
1987	0.4	0.2	---	0.4	0.8	0.3	0.5	28.7	31.3
1988	0.6	0.5	---	0.5	1.3	0.2	1.3	24.1	28.5
1989	2.5	0.2	0.0	0.5	1.4	0.1	0.2	19.8	24.7
1990	1.1	0.4	---	0.3	2.4	0.3	0.4	22.2	27.1
CPS=0, Squid≥50 MT:									
1981	0.0	0.0	0.0	62.9	12.8	0.0	42.9	9.4	128.0
1982	0.0	0.0	0.0	42.5	18.2	0.0	11.5	2.2	80.2
1983	0.0	0.0	0.0	81.5	0.0	0.0	2.7	32.7	116.9
1984	0.0	0.0	0.0	45.8	13.5	0.0	1.0	68.4	128.7
1985	0.0	0.0	0.0	62.6	11.7	---	8.3	145.1	227.7
1986	0.0	0.0	0.0	89.4	9.0	0.0	0.1	12.7	111.2
1987	0.0	0.0	0.0	89.3	19.7	3.4	0.0	26.3	153.4
1988	0.0	0.0	0.0	87.1	7.4	0.0	5.2	24.7	125.6
1989	0.0	0.0	0.0	243.6	8.3	0.0	9.9	5.7	269.2
1990	0.0	0.0	0.0	241.9	23.2	0.0	0.0	3.6	267.3
0<CPS<50 MT, CPS+Squid≥50 MT:									
1981	---	1.7	0.0	162.1	31.3	0.0	4.1	3.3	202.0
1982	0.1	2.6	0.0	100.4	30.5	0.0	0.1	11.3	139.5
1983	1.3	5.0	0.0	24.8	70.5	---	1.3	0.1	136.4
1984	0.1	0.0	0.0	75.3	0.0	0.0	9.0	297.3	381.7
1985	0.7	1.2	0.0	74.7	36.5	0.0	0.4	24.0	128.9
1986	1.5	1.3	0.1	81.2	17.3	0.0	0.0	28.7	119.2
1987	0.2	2.8	0.1	86.1	26.5	---	0.0	33.1	146.3
1988	0.6	18.9	0.1	94.1	11.6	0.0	2.1	2.7	132.4
1989	1.1	1.4	---	95.1	13.4	---	0.7	2.0	123.7
1990	0.0	4.7	---	90.0	0.0	0.4	10.3	11.0	125.6

Table 2.1.2-10 (cont.)

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS≥50 MT:									
1981	78.4	259.8	0.1	44.4	7.2	76.2	64.6	2.5	533.2
1982	46.1	260.2	---	18.6	6.7	24.7	45.9	1.7	403.8
1983	4.6	200.4	0.0	4.9	16.7	29.0	61.3	4.8	318.2
1984	3.7	225.9	---	2.0	2.1	18.9	141.3	5.6	397.8
1985	8.5	198.7	---	46.6	7.1	14.7	48.6	3.7	327.5
1986	2.8	263.3	1.6	89.7	6.5	1.2	172.6	3.8	540.9
1987	6.0	282.9	1.2	62.6	7.0	50.6	97.7	6.7	514.8
1988	8.2	227.0	4.1	123.6	4.5	42.5	144.5	5.9	558.0
1989	8.5	207.7	6.4	91.2	4.2	8.9	83.8	8.2	419.5
1990	27.3	189.5	4.6	69.6	11.2	39.4	62.7	13.8	419.1
All Round Haul Vessels:									
1981	42.8	141.3	---	51.8	10.1	41.4	37.6	2.9	327.9
1982	23.3	131.0	0.0	34.7	11.7	12.4	24.0	3.3	240.4
1983	3.4	127.3	0.0	5.7	21.3	18.4	38.9	7.5	222.5
1984	2.2	96.1	0.0	2.5	1.3	8.1	61.0	21.9	193.1
1985	2.3	46.6	---	18.3	6.6	3.5	12.4	28.2	117.9
1986	1.2	74.4	0.5	30.8	3.5	0.5	48.8	23.0	182.7
1987	2.0	84.5	0.4	25.6	4.4	15.3	29.4	22.7	184.3
1988	2.6	62.9	1.1	48.0	3.3	11.7	40.7	17.9	188.2
1989	4.1	64.2	2.0	50.6	3.2	2.8	26.7	15.3	168.9
1990	9.1	58.5	1.4	33.2	5.7	12.3	19.9	19.1	159.2

^a Vessels whose principal gear is round haul or an unspecified net gear.

--- Denotes trace amount.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-11. Selected characteristics of Washington, Oregon and California round haul vessels^a landing CPS or squid during 1981-1990, by landings category

Characteristic	Landings Category			
	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 CPS+Squid≥50	CPS≥50
Mean # vessels	75	6	10	49
Median boat length	31-40'	41-50'	41-50'	51-60'
Year built (1990 fleet):				
<1950	12.7%	0.0%	16.7%	50.0%
1951-1970	32.7%	0.0%	0.0%	2.3%
1971-1990	54.5%	100.0%	83.3%	47.7%
Principal area fished:				
Orange/Los Angeles	35.8%	7.7%	2.2%	71.4%
Ventura/Santa Barbara	13.6%	25.7%	10.1%	10.8%
Monterey/Santa Cruz	18.1%	49.4%	65.5%	15.7%
Elsewhere	32.5%	17.2%	22.2%	2.1%
Mean # trips:	47.2	54.3	57.8	65.7
%CPS	18.5%	0.0%	7.3%	69.0%
%Squid	4.3%	59.7%	61.4%	18.9%
Mean total landings (MT):	20.8	423.2	329.6	1,605.0
%CPS	22.5%	0.0%	4.6%	77.4%
%Squid	12.3%	85.7%	77.2%	14.6%
Mean total revenue	29.0	160.8	163.6	443.3
(\$1000's, Base Yr=1989):				
%CPS	6.7%	0.0%	3.4%	57.9%
%Squid	5.4%	62.4%	59.5%	11.8%

^a Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-12. Comparison of fishing patterns during 1981-1983 and 1984-1990 by Washington, Oregon and California round haul vessels^a landing less than 50 MT of CPS+squid per year

Characteristic	1981-1983	1984-1990
Mean # vessels	27	96
Principal area fished		
%Southern California	42.2%	70.0%
%Central California	47.0%	27.2%
%Other	10.8%	2.8%
Mean # trips	22.0	58.0
%CPS	26.2%	15.2%
%Squid	12.1%	0.9%
Mean total landings (metric tons)	24.3	19.3
%CPS	35.4%	17.0%
%Squid	22.3%	8.2%
%Other round haul spp. ^b	31.8%	12.8%
%Shark,swordfish,groundfish, flatfish	5.3%	40.9%
%Other non-round haul spp.	5.2%	21.1%
Mean total revenue (\$1000's, Base Year=1989)	24.2	31.5
%CPS	13.3%	3.9%
%Squid	14.7%	1.3%
%Other round haul spp. ^b	43.0%	20.3%
%Shark,swordfish,groundfish, flatfish	18.7%	64.5%
%Other non-round haul spp.	10.3%	10.0%

^a Vessels whose principal gear is round haul or an unspecified net gear.

^b Includes Pacific bonito, bluefin tuna and Pacific herring.

Source: Vessel summaries generated from WOC fish ticket data converted to PacFIN format.

Table 2.1.2-13. Mean ex-vessel price (\$/MT; base year=1989) of fish caught in Washington, Oregon and California with round haul gear, 1981-1990

Year	Anchovy	Mackerel	Sardine	Squid	Bonito	Bluefin Tuna
----	-----	-----	-----	-----	-----	-----
1981	\$88	\$286	\$282	\$361	\$811	\$2,053
1982	62	267	304	305	582	1,481
1983	179	242	322	532	462	1,983
1984	328	226	---	539	347	1,605
1985	291	204	287	380	245	1,119
1986	240	186	233	255	342	1,947
1987	245	271	158	236	596	3,340
1988	291	177	138	220	428	5,437
1989	212	152	183	174	429	1,834
1990	450	211	132	184	464	2,100

Round haul gear refers to unspecified net gears as well as round haul gear. Sardine prices apply to directed landings only. Mackerel prices apply to sardines landed in mixed loads with mackerel (which receive the same price as mackerel) as well as "pure" loads of mackerel.

--- No price reported on fish tickets.

Source: WOC fish ticket data converted to PacFIN format.

Table 2.1.2-14. Number of California fish dealers who received any CPS squid, by principal landing area, 1986-1990

County	CPS>0,Squid=0	CPS>0,Squid>0	CPS=0,Squid>0	Total
1986:				
San Diego/Orange	20	2	0	22
Los Angeles	15	12	2	29
Vent/SBarb	5	10	8	23
SanLuisObispo	7	2	1	10
Monterey/StaCruz	13	15	3	31
SanFran Bay Area	17	2	4	23
Northern Calif	1	0	2	3
Unknown	0	1	0	1
Total	78	44	20	142
1987:				
San Diego/Orange	17	4	2	23
Los Angeles	18	9	3	30
Vent/SBarb	5	14	4	23
SanLuisObispo	7	2	0	9
Monterey/StaCruz	7	14	5	26
SanFran Bay Area	13	5	6	24
Northern Calif	4	0	1	5
Unknown	1	0	0	1
Total	72	48	21	141
1988:				
San Diego/Orange	13	7	1	21
Los Angeles	19	11	1	31
Vent/SBarb	10	11	5	26
SanLuisObispo	4	1	3	8
Monterey/StaCruz	6	11	5	22
SanFran Bay Area	16	2	2	20
Northern Calif	3	1	1	5
Unknown	0	1	0	1
Total	71	45	18	134
1989:				
San Diego/Orange	23	3	1	27
Los Angeles	19	15	1	35
Vent/SBarb	10	9	6	25
SanLuisObispo	6	3	1	10
Monterey/StaCruz	9	8	6	23
SanFran Bay Area	19	1	3	23
Northern Calif	4	0	1	5
Unknown	1	0	0	1
Total	91	39	19	149

Table 2.1.2-14 (cont.)

County	CPS>0,Squid=0	CPS>0,Squid>0	CPS=0,Squid>0	Total
-----	-----	-----	-----	-----
1990:				
San Diego/Orange	26	7	3	36
Los Angeles	18	13	1	32
Vent/SBarb	8	6	4	18
SanLuisObispo	5	3	0	8
Monterey/StaCruz	8	11	5	24
SanFran Bay Area	20	6	0	26
Northern Calif	4	0	3	7
Unknown	1	0	0	1
Total	90	46	16	152

Principal landing area is the area from which a dealer received the most landings.

Source: Dealer summaries generated from California fish ticket data.

Table 2.1.2-15. Number of California fish dealers who received CPS or squi by level of production and principal landing area, 1986-1990

Year/Principal Landing Area	CPS+Sqd<500	CPS=0 Sqd≥500	0<CPS<500 CPS+Sqd≥500	CPS≥500	Total
-----	-----	-----	-----	-----	-----
1986:					
San Diego/Orange	22	0	0	0	22
Los Angeles	21	0	2	6	29
Vent/SBarb	19	1	0	3	23
SanLuisObispo	10	0	0	0	10
Monterey/StaCruz	27	0	2	2	31
SanFran Bay Area	22	1	0	0	23
Northern Calif	3	0	0	0	3
Unknown	1	0	0	0	1
Total	125	2	4	11	142
1987:					
San Diego/Orange	23	0	0	0	23
Los Angeles	19	0	1	10	30
Vent/SBarb	20	0	0	3	23
SanLuisObispo	8	0	0	1	9
Monterey/StaCruz	21	2	2	1	26
SanFran Bay Area	23	1	0	0	24
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	120	3	3	15	141
1988:					
San Diego/Orange	21	0	0	0	21
Los Angeles	19	0	1	11	31
Vent/SBarb	22	1	0	3	26
SanLuisObispo	7	1	0	0	8
Monterey/StaCruz	20	1	0	1	22
SanFran Bay Area	20	0	0	0	20
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	115	3	1	15	134
1989:					
San Diego/Orange	27	0	0	0	27
Los Angeles	23	0	2	10	35
Vent/SBarb	20	2	1	2	25
SanLuisObispo	9	1	0	0	10
Monterey/StaCruz	20	1	1	1	23
SanFran Bay Area	22	0	0	1	23
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	127	4	4	14	149

Table 2.1.2-15 (cont.)

Year/Principal Landing Area	CPS+Sqd<500	CPS=0 Sqd≥500	0<CPS<500 CPS+Sqd≥500	CPS≥500	Total
-----	-----	-----	-----	-----	-----
1990:					
San Diego/Orange	36	0	0	0	36
Los Angeles	23	0	1	8	32
Vent/SBarb	16	0	1	1	18
SanLuisObispo	8	0	0	0	8
Monterey/StaCruz	18	1	3	2	24
SanFran Bay Area	24	0	1	1	26
Northern Calif	7	0	0	0	7
Unknown	1	0	0	0	1
Total	133	1	6	12	152

Principal landing area is the area from which the dealer received the most landings.

Source: Dealer summaries generated from California fish ticket data.

Table 2.1.2-16. Mean annual landings received by California CPS/squid dealers and percentage of landings consisting of CPS and squid, by product category, 1986-1990

				Category i: CPS+Squid<500						
				Year	MT	%CPS	%Squid			
				-----	-----	-----	-----			
				1986	242.9	4.8%	6.5%			
				1987	183.1	5.9%	5.8%			
				1988	249.8	5.1%	5.6%			
				1989	221.4	3.1%	7.6%			
				1990	240.9	4.9%	2.1%			
				Avg.	227.6	4.8%	5.5%			
				Category ii: CPS=0, Squid≥500			Category iii: 0<CPS<500, CPS+Squid≥500			
				-----			-----			
Year	MT	%CPS	%Squid	MT	%CPS	%Squid	MT	%CPS	%Squid	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
1986	---	---	---	---	---	---	1,528.4	6.3%	69.	
1987	1,361.4	0.0%	63.9%	917.6	31.4%	45.0%	1,139.5	15.7%	54.	
1988	---	---	---	---	---	---	1,950.4	3.4%	84.	
1989	1,128.0	0.0%	88.5%	5,789.0	2.4%	63.1%	3,458.5	1.2%	75.	
1990	---	---	---	---	---	---	1,595.5	10.5%	81.	
Avg.	---	---	---	---	---	---	1,934.5	7.4%	73.	
				Category iv: CPS≥500						

				Year	MT	%CPS	%Squid			
				-----	-----	-----	-----			
				1986	8,649.1	55.3%	13.9%			
				1987	6,800.9	53.3%	14.6%			
				1988	7,904.8	47.8%	24.6%			
				1989	7,057.2	61.1%	20.4%			
				1990	6,509.9	58.2%	23.9%			
				Avg.	7,384.4	55.1%	19.5%			

--- As indicated in Table 2.1.2-15, fewer than three dealers fell in category ii in 1986 and 1990 and into category iii in 1988. In order to maintain confidentiality, statistics for categories ii and iii are not reported separately in this table for those three years but instead weighted averages, with the weights being the respective number of dealers in the two categories.

Source: Dealer summaries generated from California fish ticket data.

Table 2.1.2-17. Percentage of total California CPS/squid dealers and percentage of California landings of CPS and squid accounted for by dealers in each of four production categories, 1986-1990

Category i: CPS+Squid<500									
				% Cal Landgs					
Year	%Dealers	CPS	Squid						
1986	88.0%	2.7%	9.3%						
1987	84.4%	2.3%	6.4%						
1988	85.8%	2.5%	4.3%						
1989	85.2%	1.4%	5.2%						
1990	87.5%	3.3%	2.3%						
Avg.	86.2%	2.4%	5.5%						
Category ii: CPS=0, Squid≥500				Category iii: 0<CPS0500, CPS+Sqd≥500			Sum of Categories ii & iii		
% Cal Landgs				% Cal Landgs			% Cal Landgs		
Year	%Dealers	CPS	Squid	%Dealers	CPS	Squid	%Dealers	CPS	Squid
1986	---	---	---	---	---	---	4.2%	1.3%	28.5%
1987	2.1%	0.0%	13.1%	2.1%	1.5%	6.2%	4.2%	1.5%	19.3%
1988	---	---	---	---	---	---	2.9%	0.8%	17.4%
1989	2.7%	0.0%	9.8%	2.7%	0.9%	35.7%	5.4%	0.9%	45.5%
1990	---	---	---	---	---	---	4.6%	2.4%	32.0%
Avg.	---	---	---	---	---	---	4.3%	1.4%	28.5%
Category iv: CPS≥500									
				% Cal Landgs					
Year	%Dealers	CPS	Squid						
1986	7.7%	96.0%	62.3%						
1987	10.6%	96.2%	74.4%						
1988	11.2%	96.7%	78.2%						
1989	9.4%	97.7%	49.3%						
1990	7.9%	94.3%	65.7%						
Avg.	9.4%	96.2%	66.0%						

-- As indicated in Table 2.1.2-15, fewer than three dealers fell into category ii in 1986 and 1990 and into category iii in 1988. In order to maintain confidentiality, the proportion of total CPS/squid dealers and total CPS and squid landings accounted for by categories ii and iii are not reported separately in this table for those three years but instead as sums of the two categories.

Source: Dealer summaries generated from California fish ticket data.

Table 2.1.3-1. Estimated number of recreational fishing trips in California (thousands of trips), 1981-1989

Year	Shore	CPFV ^a	Private Boat	Total
----	-----	-----	-----	-----
1981	3,748	1,429	2,775	7,952
1982	3,483	2,274	2,546	8,302
1983	3,613	1,629	2,893	8,135
1984	3,742	1,349	3,199	8,292
1985	3,438	1,378	2,989	7,804
1986	3,539	1,538	3,801	8,876
1987 ^b	2,835	1,073	3,695	7,603
1988 ^b	4,540	1,535	3,862	9,937
1989 ^b	3,221	1,352	2,483	7,056

Excludes trips targeted on salmon and striped bass and all boat trips that originated in the United States but fished in Mexican waters.

^a Commercial passenger fishing vessels (CPFV's) transport passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental and fish cleaning.

^b Preliminary.

Sources: 1981-1986 data from NMFS (1984, 1985a, 1985b, 1987).
1987-1989 data from J. Witzig, NMFS,
Silver Spring, Maryland.

Table 2.1.3-2. Proportion of recreational fishing trips in southern California for which anchovy is used as live or dead bait

Bait Status	Fishing Mode			
	Beach	Pier	CPFV ^a	Private Boat
Live	3%	12%	77%	44%
Dead	33%	60%	13%	34%
Live or Dead ^b	35%	66%	84%	71%

^a Commercial passenger fishing vessels (CPFV's) transport passengers to and from the fishing grounds and provide bait, food and beverage service, gear rental and fish cleaning.

^b "Live" + "Dead" do not necessarily sum to "Live or Dead," since some anglers use both live and dead bait on a single trip.

Source: Thomson and Crooke 1991.

Table 2.1.4-1. Mexican landings of sardine and Pacific mackerel (MT) in Ensenada, Baja California, 1961-1990, as available

Year	Pacific Sardine	Pacific Mackerel
----	-----	-----
1961	0	n.a.
1962	4,580	n.a.
1963	4,269	n.a.
1964	4,907	n.a.
1965	4,286	n.a.
1966	2,575	n.a.
1967	5,846	n.a.
1968	5,135	n.a.
1969	n.a.	n.a.
1970	n.a.	n.a.
1971	n.a.	n.a.
1972	n.a.	n.a.
1973	3,258	103
1974	6,284	82
..		
1983	274	135
1984	0	128
1985	3,722	2,582
1986	243	4,883
1987	2,432	2,082
1988	2,035	4,484
1989	6,222	13,887
1990	11,375	35,767

Sources: 1961-1974 data from Osuna, et al. 1976.
1983-1990 data from W. Garcia, Instituto Nacional
de Pesca, Ensenada, Baja California.

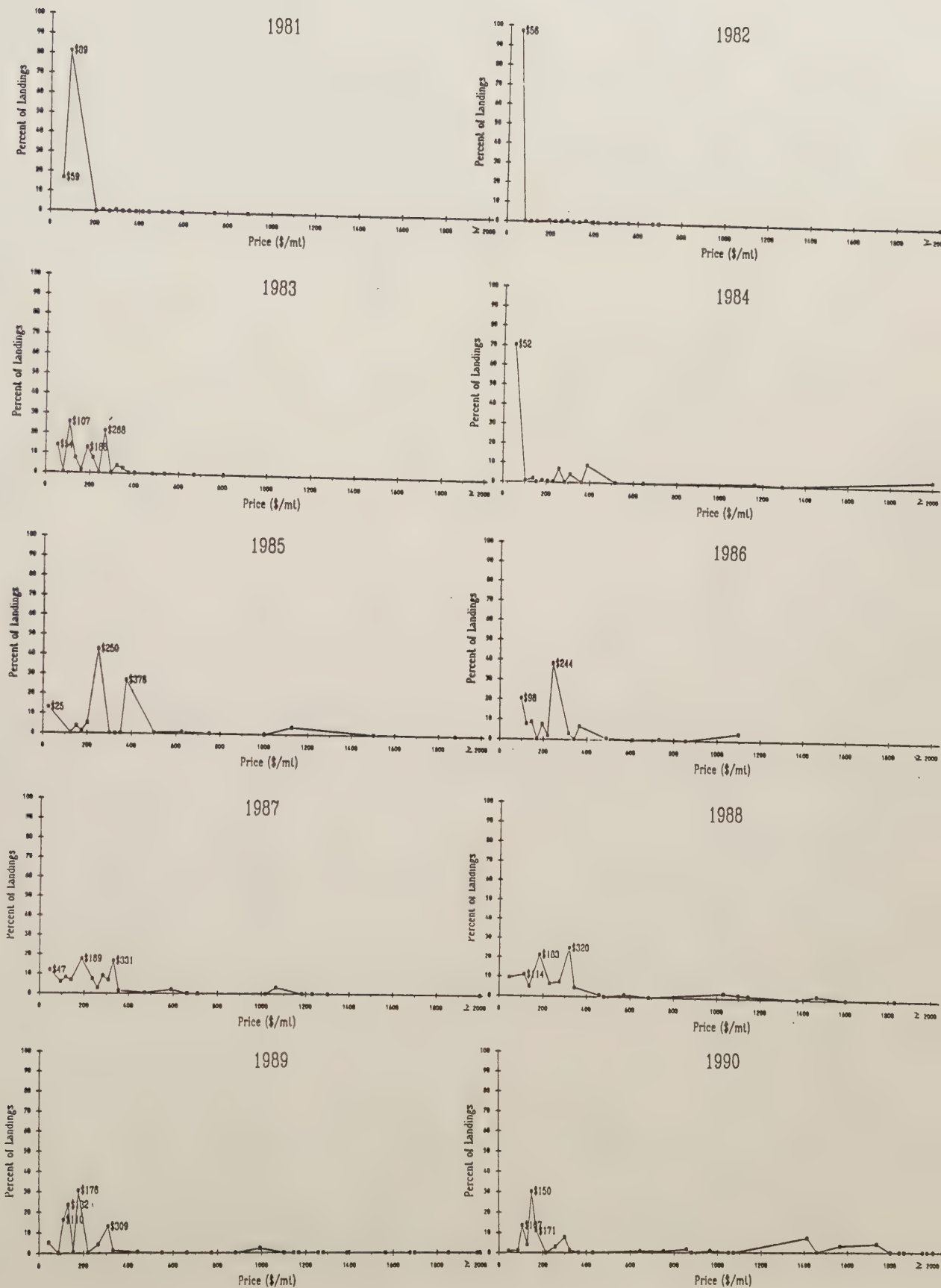


Figure 2.1.2-1a. Price distribution of anchovy landed with round haul gear, 1981-1990 (Base Year=1989).

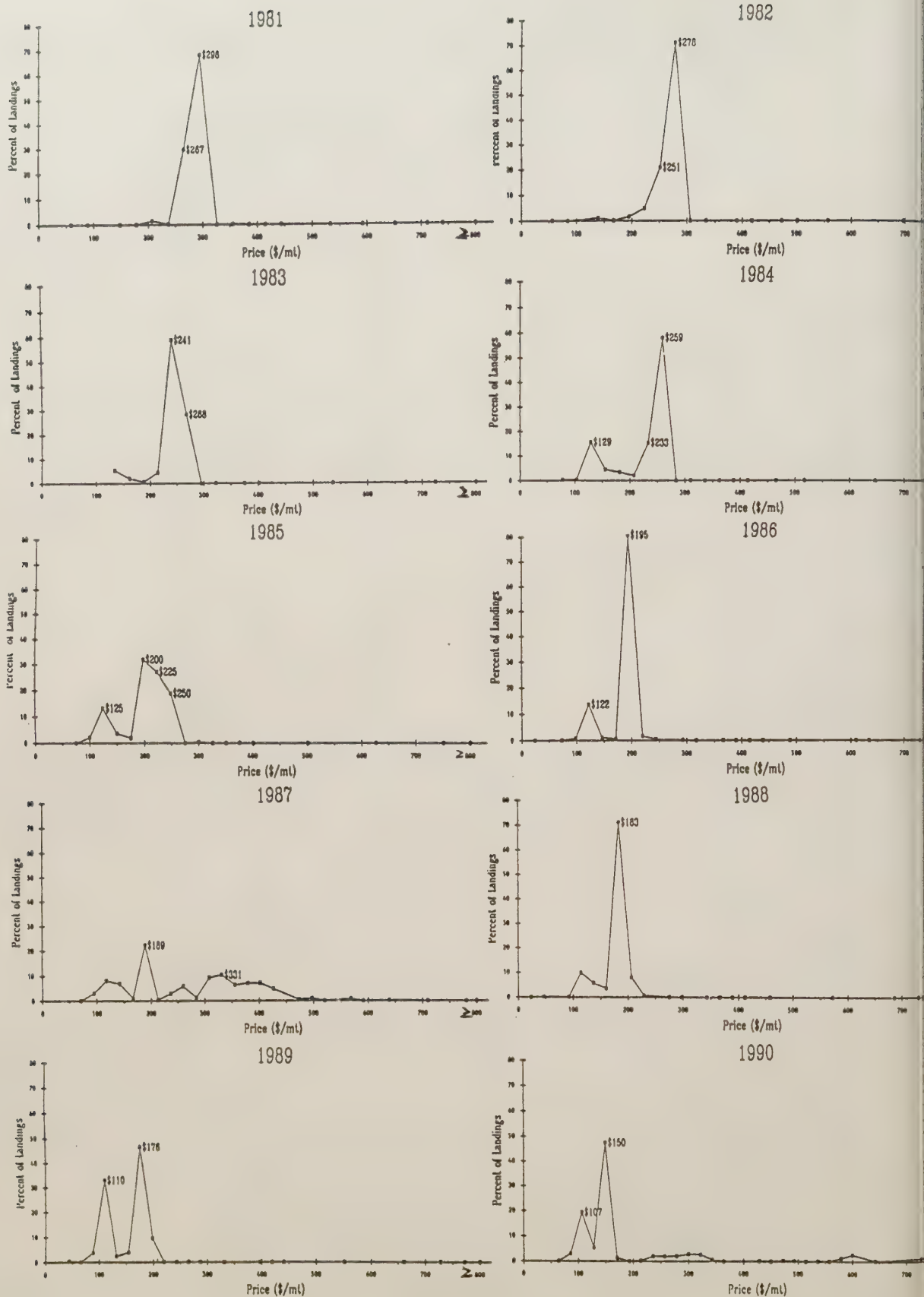


Figure 2.1.2-1b. Price distribution of mackerel landed with round haul gear 1981-1990 (Base Year=1989).

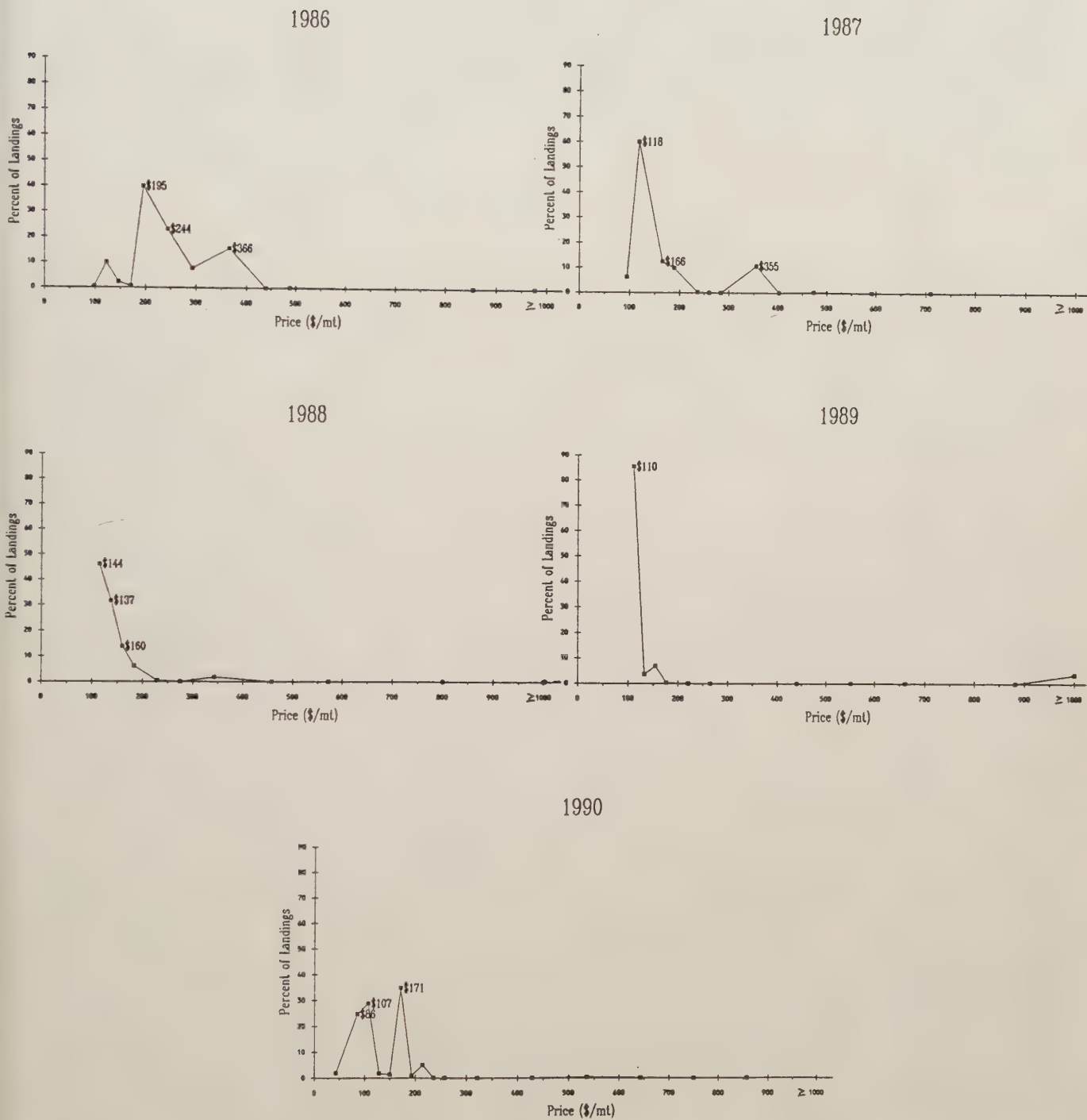


Figure 2.1.2-1c. Price distribution of sardine landed with round haul gear, 1986-1990 (Base Year=1989).

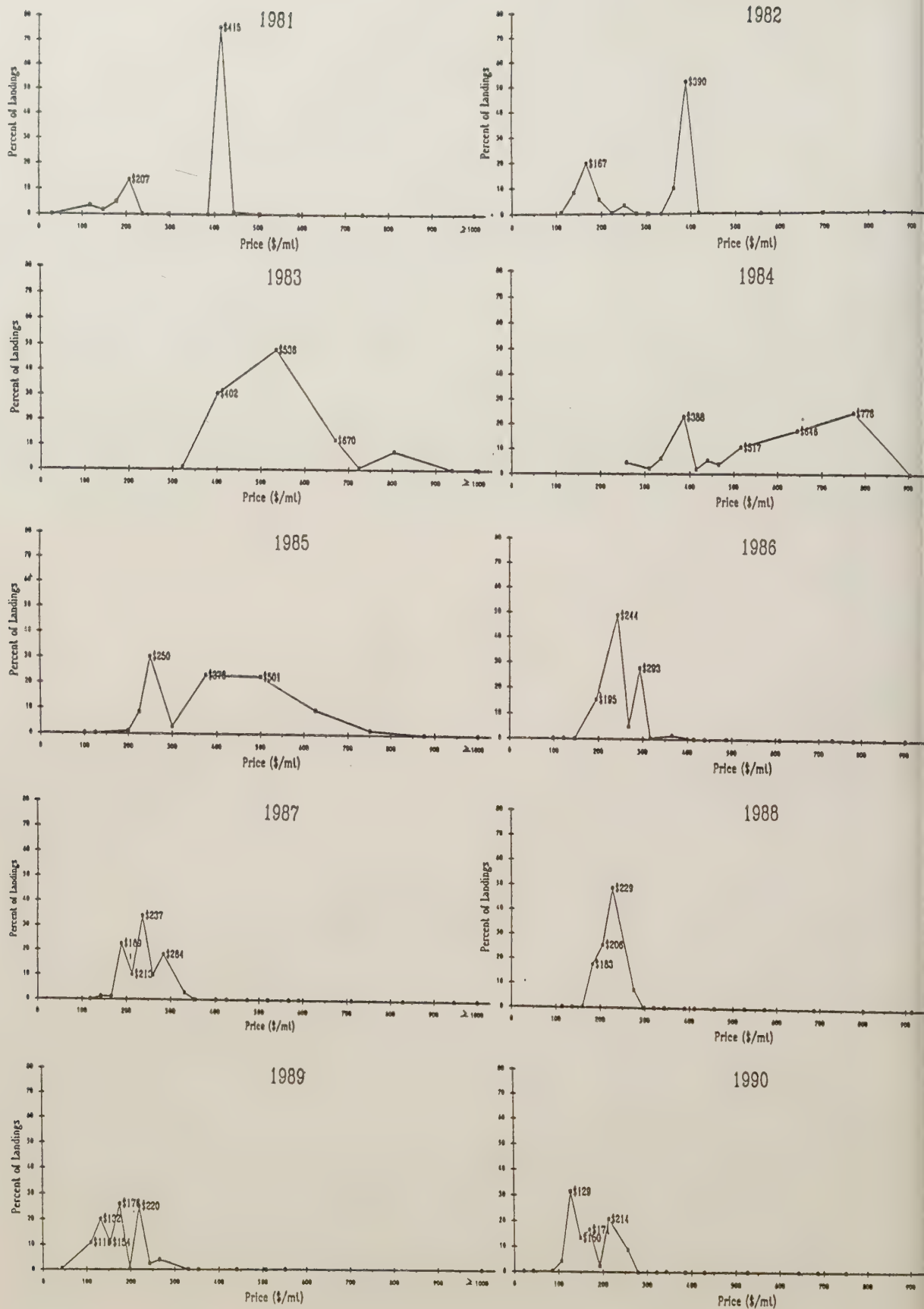


Figure 2.1.2-1d. Price distribution of squid landed with round haul gear, 1981-1990 (Base Year=1989).

2.2 - Other Fisheries Component

The other fisheries component consists of three overlapping commercial fisheries. One segment harvests Pacific whiting off northern California, Oregon and Washington; another segment harvests pelagic and midwater rockfish in the same area; and the last segment harvests walleye pollock and other species in the north Pacific, and processes them at sea.

2.2.1 - Pacific Whiting

2.2.1.1 - History

Before 1965, Pacific coast fishermen considered whiting a nuisance; the only landings of consequence were taken incidentally by U.S. vessels using otter trawls off central and northern California (Nelson 1970). Annual landings of whiting in California averaged only 225 MT from 1959 through 1965 and most of the catch was used for pet food and as food in the fur industry. Because whiting did not keep well, it was not marketed as food for humans. It was thought that whiting could not be economically harvested on a large scale for industrial markets because of its low abundance and distribution.

In 1964, surveys off the Washington and Oregon coasts found dense schools of whiting that were large enough to be economically harvested by a midwater trawl fishery. By 1966, the relatively unexploited resource had attracted a large distant-water Soviet trawl fleet, and a directed foreign fishery for whiting and Pacific ocean perch began (Hitz 1970). By 1967, the annual Soviet harvest of Pacific whiting (113,000 MT) was about fourteen times larger than the harvest of Pacific ocean perch.

The Soviet whiting fleet of the 1960s consisted of side trawlers, stern and side trawlers with onboard processing facilities, freezer ships or freezer/processors, and various support ships (including refrigerated transports, tankers and rescue tugs). Smaller side trawlers, without processing and storage capacity, delivered their catches to freezer ships on completion of a tow. Freezer ships would then process, freeze and store the product for delivery to port at the end of the season, or transfer it to refrigerated transport vessels. Larger side trawlers and stern trawlers could also freeze or process their catches on board and transfer the processed product to refrigerated transports. Factory trawlers produced frozen product, meal and oil. The largest of the freezer ships had freezing, canning and salting capability, as well as reduction equipment.

The Pacific whiting fishery continued to be dominated by foreign interests until the late 1970s, when the Magnuson Fishery Conservation and Management Act (MFCMA) was implemented. Under the MFCMA, foreign vessels are allowed to harvest whiting in the U.S. EEZ only if the U.S. fishing industry has not demonstrated intent to harvest the entire OY. Under this system, needs of domestic

processors are satisfied first, then JV operations involving U.S. catcher boats that deliver whiting to foreign vessels for processing at sea and, finally, needs of purely foreign segments of the fishery. JV arrangements were mutually beneficial because U.S. fishermen were paid for delivering species for which there was little or no demand in U.S. markets. Under the MFCMA, the Soviet Union, Poland, Bulgaria, the People's Republic of China, the Republic of Korea and Japan fished for whiting off Washington, Oregon, and California.

Consistent with the intent of the MFCMA, JV and shore-based deliveries of whiting by U.S. vessels increased significantly after 1978 and eventually displaced the foreign fishery entirely (Table 2.2.1.1-1). In 1978, the foreign harvest was 98% of the total whiting harvest, but in 1988 the directed foreign fishery accounted for only 11% of total whiting landings while the JV fleet accounted for 85%, and shore-based landings accounted for 4%.

The first joint venture was initiated in September of 1978, when two U.S. trawlers delivered about 900 MT of whiting to two Soviet factory trawlers during a six-week period. In 1979, joint venture interests announced intentions to harvest 35,000 MT of whiting, although only about 9,000 MT (taken by seven U.S. trawlers) were actually taken. These vessels, fully equipped for midwater trawling, ranged from 70 to 110 feet and had engines of 365 to 1,100 horsepower. Daily deliveries of 100-600 MT were made to as many as seven USSR processing vessels. Most whiting taken in the JV fishery were headed, gutted and frozen; a small portion was filleted; the remainder was reduced to meal. The bulk of this production was exported to the Orient, eastern Europe and the Soviet Union.

By 1988 over 40 U.S. vessels were participating in JV whiting operations (Table 2.2.1.1-2). Ships ranged in length from 54 to 117 feet and had engines of 340 to 1,700 horsepower. During the 1988 season, vessels averaged 69 days of fishing and 2.8 deliveries per day. Daily deliveries averaged 2,000 MT in total and 47 MT per vessel.

In 1989, 65 U.S. catcher vessels delivered a record 204,000 MT of whiting to foreign processors. This number, together with shore-based landings of 7,000 MT, made up 94% of the total OY of 225,000 MT.

In 1989 and subsequently, there was no foreign fishing for whiting because domestic needs exhausted the available supply. The 1990 OY and quota for whiting (196,000 MT) was 13% lower than in 1989, and JV requests alone were greater than the total OY.

The number of foreign trawlers varied considerably from 1981 to 1989—from 31 in 1981 to 0 in 1989 (Table 2.2.1.1-3). In the JV fishery, the number of foreign processor vessels as well as the number of domestic catcher vessels increased. From July 1984 through December 1989, 117 vessels had both JV and shoreside whiting landings; 55 vessels had JV landings only; and 19 vessels had shoreside landings only (NMFS data).

In 1990, another major change occurred when three domestic catch-processor vessels entered the fishery for the first time.

Before 1990, the U.S. at-sea processing fleet operated almost exclusively in north Pacific groundfish fisheries.

When the Bering Sea pollock fishery was closed during 1991, factory trawlers again participated in the whiting fishery off Washington, Oregon and California. Preliminary catch reports issued by NMFS indicate that 16 vessels, 3 operating as mother ships and 13 as catcher/processors, caught and processed whiting during 1991. Seventy-eight thousand MT were processed by mother ships, and 117,000 MT were harvested and processed by catcher/processors. Because domestic processing needs take precedence, this development, together with increased requests from shore-based processors, completely displaced the JV fishery in 1991.

2.2.1.2 - Bycatch

Species caught incidentally during foreign and domestic fishing for whiting include salmon, Pacific halibut, Pacific ocean perch, jack mackerel, rockfish (mainly widow and yellowtail rockfish), flatfish (mainly dover sole and arrowtooth flounder), sablefish, jelly fish, squid and other species. Bycatch in the JV for whiting is not counted against quotas used to manage directed fisheries. In order to discourage discard, only small allowances for bycatch are permitted.

Allowances in the JV whiting fishery are based on historical proportions of bycatch species in deliveries of whiting to foreign processor vessels. Since 1980, the incidental catch allowances in the JV whiting fishery have been: jack mackerel (north of 39° N) 3.0%; Pacific ocean perch 0.062%; other rockfish (except Pacific ocean perch) 0.738%; flatfish 0.1%; sablefish 0.173%; and other species 0.5%. Less than 5% of the annual U.S. catch of "whiting" delivered to foreign processing vessels (including species that were subsequently discarded) is bycatch species (Table 2.2.1.2-1). From 1980 to 1991 catches of jack mackerel, the only CPS taken incidentally in appreciable amounts in the whiting fishery, have been less than 400 MT annually.

2.2.1.3 - Fishing Gear

U.S. fishermen use midwater trawl gear principally to harvest whiting, but this gear is also useful for catching widow rockfish, shortbelly rockfish and jack mackerel. Midwater trawling by U.S. fishermen developed in the late 1970s, when larger trawlers began towing specialized, off-the-bottom trawl nets at varying depths. Because of the difficulty in towing and positioning the net, this type of fishing requires a vessel that has more horsepower and electronics than vessels typically used for bottom or shrimp trawling.

2.2.1.4 - Seasonal Patterns

The whiting fishery is seasonal (spring and summer), and vessels that harvest whiting usually engage in other fisheries

during the off-season. Vessels participating in the JV whiting fishery have also operated in the Pacific coast midwater trawl fisheries for widow rockfish and pink shrimp, as well as in the bottom trawl fishery for groundfish. Vessels in the JV fishery for whiting have also participated in Alaskan shoreside and JV fisheries during the off-season. Recently, however, there has been a dramatic increase in the number of large factory trawlers operating in Alaska, and off-season opportunities have been severely curtailed.

2.2.1.5 - Capability of Vessels to Engage in Other Fisheries

Vessels used to harvest whiting can participate in other fisheries because they tend to be relatively new, highly powered and electronically advanced. The fishery for widow rockfish is the most important alternate midwater trawl fishery for U.S. vessels that harvest whiting. Jack mackerel and shortbelly rockfish, currently underutilized species, are alternative targets that may become important in the near future. Of the total number of fishing trips (48,995) made by U.S. vessels that landed JV or shoreside whiting from July 1984 through December 1989, 36% were non-whiting trips, 26% were whiting trips, 17% were halibut trips, 10% were shrimp trips, and 6% were crab trips.

2.2.1.6 - Landings and Revenues in the Midwater Trawl Fishery

Annual midwater trawl landings averaged 109,000 MT from 1981 to 1989, and ex-vessel revenues averaged \$18 million. Midwater trawl landings and ex-vessel revenues fell to respective lows of 45,000 MT and \$10 million in 1985, then climbed to highs of 224,000 MT and \$29 million in 1989 (Table 2.2.1.6-1).

2.2.1.7 - Operating Costs

As indicated by an NMFS survey, the annual fixed costs associated with owning and operating a JV whiting vessel in 1987 averaged \$255,224 per vessel, and variable costs averaged \$6,085 per week fished. In 1987, the JV whiting fleet fished approximately 377 vessel weeks (an average of 12.2 weeks per vessel), and total variable costs for JV whiting fishing averaged \$74,237 per vessel. Average revenue per vessel from the JV whiting fishery in 1987 was \$194,000.

2.2.1.8 - Processing Sector

Before 1991, 95% of the total U.S. whiting harvest was taken by JV vessels that delivered to foreign processors, and less than 5% went to shoreside processors for heading and gutting. In 1991 more than 163,000 MT of whiting were processed at sea by nine U.S. companies. A survey by NMFS in June 1991 revealed that production by U.S. at-sea processors was 48% surimi, 28% fillet blocks, 7% minced blocks, and 17% meal.

2.2.1.9 - Management

Since 1982, fishing operations for whiting within the U.S. EEZ have been managed through the FMP for Pacific coast groundfish (PMFC 1990). Annual OY levels and quota for whiting have been specified since 1978. When the total OY for whiting cannot be fully utilized by domestic processors, the surplus is allocated to JV processing and—if any surplus remains after JV needs are met—to directed foreign fishing in the form of a quota or TALFF (total allowable level of foreign fishing). The allocation to JV processing may be either a quota or harvest guideline. When there is no surplus, the domestic fishery receives the entire OY. In addition to restrictions on whiting catches, incidental allowances have been instituted for species or species groups that are caught incidentally with whiting. Whenever a quota or incidental allowance is reached, the fishery can be shut down.

In terms of their operations, U.S. vessels fishing for whiting (JV or shoreside) are treated in the same way as groundfish vessels delivering shoreside. Foreign vessels fishing whiting under a TALFF can operate in the EEZ only outside 12 miles, between 39° and 47°30' N latitude and from June 1 to October 31. The JV fishery is restricted to north of 39° N. Furthermore, foreign vessels engaged in JV's or directed foreign fishing are subject to a number of reporting and recordkeeping requirements.

Table 2.2.1.1-1. Landings and quotas for Pacific whiting,
1984-89

Year	Foreign Fishing (MT)	Joint Venture (MT)	USa Process (MT)	Totalb Landings (MT)	Optimum Yield (MT)	Quota Landed (%)
1978	96,827	856	689	98,372	130,000	76
1979	114,910	8,834	937	124,681	198,900	63
1980	44,023	27,537	793	72,353	175,000	41
1981	70,366	43,557	838	114,761	175,000	66
1982	7,098	67,465	1,024	75,578	175,500	43
1983	0	72,100	1,051	73,151	175,500	42
1984	14,772	78,889	2,721	96,382	175,500	55
1985	49,853	31,692	3,894	85,439	175,000	49
1986	69,861	81,639	3,463	154,963	295,800	52
1987	49,656	105,997	4,795	160,448	195,000	82
1988	18,041	135,871	6,876	160,698	232,000	69
1989	0	203,578	7,418	210,996	225,000	94
1990	0	170,972	12,828	183,825	196,000	94

a U.S. processing was entirely shore based until 1990, when three domestic catch/processor vessels briefly entered the fishery.

b Preliminary.

Table 2.2.1.1-2. Deliveries (thousand MT), revenues and boats in the joint-venture Pacific whiting fishery, 1978-1989

Year	<u>Number of Vessels</u>		Tonnage	<u>U.S. Catcher Vessels</u>		
	U.S. Catcher	Foreign Processors		Revenue	Tonnage/Vessel	Revenue/Vessel
1978	2	2	.9	NA	.45	NA
1979	11	10	8.8	1.8	.8	.164
1980	16	11	27.5	4.7	1.7	.294
1981	21	20	43.6	8.0	2.1	.381
1982	19	15	67.5	12.5	4.0	.735
1983	19	15	72.1	12.0	3.8	.632
1984	21	20	78.9	13.3	3.8	.633
1985	18	15	31.7	4.1	1.9	.241
1986	25	23	81.6	4.7	3.3	.188
1987	31	30	106.1	6.0	3.4	.194
1988	40	31	135.8	7.3	3.2	.175
1989	65	45	203.8	20.9	3.1	.321
1990	48	34	NA	NA	NA	NA
Avg.	29	24	91.2	9.9	3.3	.389

Source: PacFIN Management Database.

Table 2.2.1.1-3. Number of vessels and catches (thousand MT) for foreign and joint-venture fisheries for Pacific whiting, 1981-1989

Year	Foreign Vessels		U.S. Catcher Vessels	Total Harvest	Percent of Total Harvest		
	Foreign Trawl.	JV Proc.			Direct. Foreign Fishery	JV Fishery	Domestic Shore.
1981	31	20	21	114.8	61.3	38.0	0.7
1982	4	15	19	75.6	9.3	89.3	1.4
1983	0	15	19	73.2	0.0	98.6	1.4
1984	17	20	21	96.4	15.3	81.9	2.8
1985	22	15	18	85.4	58.4	37.1	4.5
1986	24	23	25	155.0	45.1	52.7	2.2
1987	33	30	31	160.4	31.0	66.0	3.0
1988	16	31	40	160.7	11.2	84.5	4.3
1989	0	44	65	211.0	0.0	96.7	3.3
1990	0	34	48	NA	NA	NA	NA

Table 2.2.1.2-1. Bycatch of various species in the Pacific whiting joint-venture fishery, 1980-1990

Year	J. Mack ^a	Rockfish ^a	POP ^a	Species		Other ^a	Salmon ^b	Halibut ^b
				Flatfish ^a	Sablefish ^a			
1980	75	448	29	46	213	122	3,602	0
1981	73	591	30	1	254	635	6,422	0
1982	1 ^c	832	25	6	54	770	11,694	43
1983	30	727	7	2	30	350	5,143	46
1984	79	561	9	1	25	90	10,192	26
1985	2	294	1	1	4	39	1,575	31
1986	42	773	20	5	22	326	32,051	96
1987	410	643	2	17	13	67	8,636	49
1988	182	659	2	36	72	162	13,984	131
1989	12	426	3	81	9	136	9,199	110
1990	187	635	3	93	16	118	9,367	77

^a Landings in metric tons.

^b Landings in number of fish.

^c Less than .5 metric tons.

Table 2.2.1.6-1. Quantity (thousand MT) and value (millions 1988 dollars) of midwater trawl landings, 1981-1989

Year	<u>Widow Rockfish</u>		<u>Shoreside Whiting</u>		<u>JV Whiting</u>	
	Landings	Value	Landings	Value	Landings	Value
1981	28.2	10.9	0.8	0.3	43.6	8.0
1982	26.0	10.9	1.0	0.1	67.5	12.5
1983	10.5	5.2	1.1	0.1	72.1	12.0
1984	9.6	5.5	2.7	0.3	78.9	13.3
1985	8.9	5.4	3.9	0.4	31.7	4.1
1986	9.4	6.0	3.5	0.4	81.6	4.7
1987	12.2	8.9	4.8	0.5	106.0	6.0
1988	10.9	6.9	6.9	0.9	135.8	7.3
1989	12.7	7.0	7.0	0.9	204.0	20.9
Average	14.3	7.4	3.4	0.4	91.2	9.9

2.2.2 - Domestic Fisheries in the North Pacific That Harvest and Process at Sea

Before 1989, there was little domestic offshore processing except for a few pot and longline vessels that dressed their sablefish catches at sea. Domestic offshore processing of whiting did not begin until the winter of 1990. But in the north Pacific a fleet of factory trawlers has grown rapidly in recent years. This fleet is currently concentrated in Alaskan waters, but more restrictive management measures in the walleye pollock and north Pacific groundfish fisheries, and the inability of resources in the north Pacific to support continued expansion of the fleet have prompted interest by domestic factory trawlers and offshore processors in the harvest of Pacific whiting, jack mackerel and shortbelly rockfish.

2.2.2.1 - Number of Vessels

The north Pacific U.S. factory trawler fleet did not exist before 1980. Since 1986, the fleet has grown rapidly from 12 vessels (ranging in size from 130 to 340 feet) to 50 vessels in 1989 and more than 60 in 1991. The 1991 fleet represents an investment of over \$1.0 billion, and a harvesting capacity greater than 2.0 million MT per year. Because of the enormous capital expenditure and relatively low value of products, the factory trawler fleet depends on large harvests and year-round fishing for profitable operations.

2.2.2.2 - Value and Volume of Landings

Factory trawlers operating in the Bering Sea and Gulf of Alaska target walleye pollock, Pacific cod, flatfish, rockfish, Atka mackerel and sablefish. Total groundfish catches by the factory trawler fleet have risen from 106,000 MT valued at \$29 million in 1986, to 1,047,000 MT valued at \$237 million in 1989 (Table 2.2.2.2-1). Catch per vessel increased from 8,800 MT to 21,000 MT while revenues per vessel increased from \$2 million to \$5 million.

2.2.2.3 - Future Developments

As long as opportunities for profitable operations off Alaska exist, the factory trawler fleet will probably not move into the Pacific coast CPS fishery on a large scale. During the 1991 April-May closure of the Bering Sea pollock fishery, however, several factory trawlers came south to participate in the whiting fishery. Preliminary catch reports issued by NMFS indicate that 17 vessels landed or processed 163,000 MT of whiting through the middle of June: 55,000 MT were processed by 3 mother ships, and 108,000 MT were harvested and processed by 14 catcher/processors. Most recently, U.S. factory trawlers have expressed an interest in fishing for jack mackerel and shortbelly rockfish, although

exploratory fishing by a few vessels resulted in very small catches.

Table 2.2.2.2-1. Landings and revenues for the Alaskan factory trawler fleet, 1986-1989

Year	<u>Pollock</u>		<u>Sablefish</u>		<u>Pacific Cod</u>		<u>Flatfish</u>		<u>Rockfish</u>		<u>Atka Mackerel</u>		<u>Other</u>		<u>Total</u>	
	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.
1986	56.2	9.2	8.3	9.2	28.3	6.2	6.8	2.3	6.0	2.1	0.6	0.3	0.6	0.3	106.2	29.3
1987	148.4	23.8	11.4	13.4	44.2	15.8	21.6	6.5	13.5	6.9	0.3	0.3	0.3	0.3	239.4	66.7
1988	380.3	62.0	14.3	29.4	73.8	20.9	39.4	12.5	19.2	10.9	2.0	0.1	0.5	1.0	529.5	136.8
1989	847.3	147.2	11.8	20.3	102.4	34.5	37.7	10.6	29.0	18.0	18.0	6.3	0.8	0.2	1047.0	237.1
MEAN	358.1	60.6	11.5	18.1	62.2	19.4	26.4	8.0	16.9	9.5	10.0	3.2	0.6	0.5	480.5	117.5

Landings in thousands of MT round weight, revenues based on ex-vessel prices that do not include value added by at-sea processing (in nominal dollars).

Source: PacFIN Management Database.

2.2.3 - Rockfish

Widow and shortbelly rockfish form pelagic and midwater aggregations. Widow rockfish currently support a significant fishery; shortbelly rockfish are underutilized.

Widow rockfish congregate over rocky banks from Baja California to Kodiak Island, Alaska. They frequently form dense midwater schools at night, allowing for large catches with minimal effort. Pacific coast landings of widow rockfish were negligible before the midwater trawl fishery developed in 1978-79. Coastwide landings increased rapidly from 4,941 MT in 1979 to approximately 27,000 MT in 1981 and 1982. Landings dropped dramatically after implementation of the groundfish FMP in 1982, when trip limits were imposed to prevent catch levels from exceeding the ABC. Since then, trip limits have maintained landings at about the 10,000-12,000-MT range. There is no TALFF or JV allowance for widow rockfish because this species is completely used by domestic processors.

Shortbelly rockfish are underutilized by domestic fishermen and available for foreign exploitation within the U.S. EEZ. A small experimental joint venture for shortbelly rockfish was conducted in 1982 and produced landings of 638 MT, but markets for the product did not develop and there have been no further joint ventures. Shortbelly rockfish are most common south of 39° N latitude, but current regulations prohibit any JV harvest of shortbelly rockfish south of 39° N. A request to conduct a joint venture for shortbelly rockfish in 1989 was denied on the basis that much of the area needed for the fishery should be closed to foreign vessels for national security reasons. In 1991, U.S. factory trawlers expressed an interest in fishing for shortbelly rockfish south of 39° N.

2.2.3.1 - Bycatch

The fishery for widow rockfish results in little bycatch because the fish are usually found in nearly pure schools. Species sometimes caught incidentally include yellowtail rockfish, Pacific ocean perch, bocaccio, canary rockfish, sharpchin rockfish and Pacific whiting (Tagart 1987).

2.2.3.2 - History

Prior to 1978, widow rockfish were an underutilized species in the Pacific coast groundfish fishery. In 1978, a directed midwater trawl fishery for widow rockfish began to develop as new technology incorporating electronic navigation, fish-finding equipment and midwater nets extended fishing operations into previously unfished areas and enabled vessels to follow shifts in widow rockfish concentrations throughout the year (Demory 1987; Quirollo 1987; Tagart 1987). The fishery for widow rockfish is almost exclusively a single-species, midwater trawl fishery. But widow rockfish have also been taken in setnet, bottom trawl and longline operations.

2.2.3.3 - Seasonal Patterns

Widow rockfish are available year-round, and management under trip limits is intended to maintain landings throughout the year without exceeding the annual quota. Under these circumstances the directed fishery for widow rockfish would not be considered a naturally occurring seasonal fishery. However, vessels that harvest widow rockfish can also participate in the seasonal Pacific whiting, pink shrimp and other (e.g., crab and salmon) seasonal fisheries and therefore may harvest widow rockfish only part of the year.

2.2.3.4 - Processing Sector

Widow rockfish are processed onshore. Individual trawl catches are iced immediately and delivered as quickly as possible to shoreside processors to maintain top quality. Processors like widow rockfish because they generally give relatively high recovery rates during the filleting process.

Both onshore and offshore processing capacity for shortbelly rockfish exists should a fresh fish market develop. Offshore processors also can make surimi.

2.2.3.5 - Capability of Vessels to Engage in Other Fisheries

The Pacific whiting fishery is the most important alternate midwater fishery for U.S. vessels. Jack mackerel and shortbelly rockfish, currently underutilized species, can also be harvested with midwater trawl gear. Because the vessels in the midwater whiting fishery are relatively new, highly powered and electronically advanced, they can participate in a number of other trawl and non-trawl fisheries. From July 1984 through December 1989, U.S. vessels with midwater trawling capability made 48,995 fishing trips: 36% for non-whiting, 26% for whiting, 17% for halibut, 10% for shrimp and 6% for crab.

Any catcher vessel or factory trawler capable of harvesting Pacific whiting or widow rockfish could also harvest shortbelly rockfish.

2.2.3.6 - Landings and Revenues

Annual midwater trawl landings of widow rockfish averaged 14,300 MT from 1981 through 1989, and ex-vessel revenues averaged \$7.4 million (Table 2.2.3.6-1).

Shortbelly rockfish has not been significant in the Pacific coast groundfish fishery (Table 2.2.3.6-2).

2.2.3.7 - Operating Costs

An NMFS survey indicated that annual fixed costs associated with owning and operating a midwater trawl vessel in 1987 averaged \$117,215. Variable costs averaged \$4,128 per week fished per

vessel.

2.2.3.8 - Horizontal and Vertical Integration

The harvesting and processing operations in the Pacific coast groundfish fishery are not vertically integrated. Shoreside processors have traditionally relied on independent vessels to supply them with widow rockfish.

Harvesting and processing would be completely integrated if the resource were completely utilized in a factory trawler operation.

2.2.3.9 - Recreational Harvest

Widow rockfish is not important in the recreational fishery. A survey of the California recreational party boat fishery from 1977 through 1979 revealed that only 3.7% of the catch per unit of angling effort was from widow rockfish. The catch was greatest in the northern California ports, during winter (Cooperrider 1987).

2.2.3.10 - Management

Since 1982, fishing operations for widow and shortbelly rockfish have been managed through the FMP for Pacific coast groundfish (PMFC 1990). Annual estimates of ABC for widow rockfish are used to set limits on total catch. In 1983, trip limits were first imposed to keep the annual catch from exceeding the ABC and to maintain landings through the end of the year. The OY and quota for shortbelly rockfish has been set at 10 MT each year since 1982.

There is no directed foreign fishing or JV fishery for widow rockfish in the U.S. EEZ. The resource is fully utilized by the domestic fishery and is expected to remain that way. As an underutilized species, shortbelly rockfish may be taken by foreign fishers or joint ventures.

Table 2.2.3.6-1 Landings (thousand MT) and value (millions of 1988 dollars) for widow rockfish 1981-1989

Year	Landings	Value
1981	28.2	10.9
1982	26.0	10.9
1983	10.5	5.2
1984	9.6	5.5
1985	8.9	5.4
1986	9.4	6.0
1987	12.2	8.9
1988	10.9	6.9
1989	12.7	7.0
Average	14.3	7.4

Table 2.2.3.6-2. Landings (MT) and OY levels for shortbelly rockfish, 1982-1989

Year	Landings	OY Quota
1982	4	10.0
1983	0	10.0
1984	1	10.0
1985	11	10.0
1986	2	10.0
1987	0	10.0
1988	0	10.0
1989	2	10.0

3.0 - Socioeconomics of the Coastal Pelagic Fishery

Most CPS landings are made in California, but communities in Oregon and Washington may also be affected by the management of the fisheries. Socioeconomic analysis in this report is generally at the county level, but community-level information is included where available and appropriate. Dollar amounts are adjusted for inflation using 1989 as the base year. Boats are assigned to a gear type or location category by "plurality of landings." For example, a boat that used round haul gear to land 40% of its landings, gill nets to land 30% and hook and line to land 30% would be defined as a round haul boat.

In this report, demographic data demonstrating changes in the racial and ethnic proportions of coastal counties are discussed. Racial and ethnic groupings may overlap: a group of people with Hispanic ethnicity, for example, might have various racial backgrounds. The ethnic groups discussed in this report distinguish people with Hispanic ancestry from people without Hispanic ancestry. The racial groups discussed in this report are white, black, American Indian, Eskimo or Aleutian Islander, and Asian or Pacific Islander.

3.1 - Commercial Fleet

West Coast regions where CPS have been landed commercially during 1986-89 and that are likely to be affected by management efforts are summarized in Table 3.1-1. Most CPS landings and revenues were in Los Angeles and Orange counties, where 87% of total coastal landings (200,000 MT) and 88% of real revenues (\$38.1 million in 1989 dollars) occurred during 1986-89. The largest number of vessels (194 boats, or 33% of the West Coast total) landing CPS were located in the same region. Fishing effort (number of trips in which CPS were landed) in Los Angeles and Orange counties was 64% of the total.

Ventura and Santa Barbara counties were second, with 10% of total CPS landings and 8% of real revenues during 1986-89. Monterey and Santa Cruz counties were third, with 2% of total landings and 2% of real revenues. Together, Los Angeles, Orange, Ventura, Santa Barbara, Monterey and Santa Cruz counties accounted for 97% of total CPS landings.

Vessels using round haul gear (purse seines and lampara nets) from 1986 to 1989 were responsible for 99% of CPS total landings (230,000 MT) and real revenues (\$43,000 in 1989 dollars) (Table 3.1-2). Other segments of the fishery took small amounts of CPS.

The round haul fleet during 1986-89 consisted of 315 vessels (54% of all the vessels that landed CPS) and made 11,664 trips (86% of total CPS trips) (Table 3.1-2). Round haul boats in Los Angeles and Orange counties made 86% of total CPS landings (200,000 MT) and earned 87% of total CPS revenues (\$37.8 million). Real revenues for round haul boats in Los Angeles and Orange counties averaged \$75,000 per boat per year.

Round haul vessels in Ventura and Santa Barbara counties

during 1986-89 landed 10% of the CPS and made 8% of the real revenues. Revenues from CPS for round haul boats in Ventura and Santa Barbara counties averaged \$17,000 per boat per year.

Round haul vessels in Monterey and Santa Cruz counties accounted for 2% of total CPS landed and CPS revenues. Ex-vessel revenues for CPS averaged \$6,000 per year.

3.1.1 - "Wetfish" Fleet

The southern California round haul fleet, known locally as the "wetfish fleet", is the most important sector of the CPS fishery in terms of landings (Jacobson and Thomson, in press). The wetfish fleet is based primarily in Los Angeles Harbor, with small segments in the Ventura and Monterey areas. It harvests Pacific bonito, market squid, bluefin tuna and other tunas, as well as CPS managed under this FMP. During 1989, the fleet consisted of 38 active purse seiners averaging 20 meters in length (Thomson et al. 1991). Approximately one-third of the fleet were steel-hulled boats built during the last 20 years. The rest were wooden-hulled, built in the heyday of the Pacific sardine fleet, from 1930 to 1949 (Murphy 1966).

3.1.2 - Bait (Nonreduction) Fleet

In 1990, the CPS nonreduction, or bait, fleet consisted of 18 vessels (Thomson et al. 1991) distributed along the California coast, with 16 in southern California. The fleet employed lampara nets and drum seines. Sixteen of the boats derived most of their revenue from live bait, although they also landed anchovy for dead bait and pet food. The other two vessels fished primarily for nonreduction uses other than live bait. (Several additional vessels have occasionally targeted anchovies when their preferred species were unavailable, or landed anchovies incidentally.)

The live bait fleet targeted a variety of species in 1990, including anchovy, squid, sardine, mackerel, white croaker and queenfish. Anchovies made up 85% (4,841 MT) of the total (5,432 MT) live bait catch (Thomson et al. 1991).

3.2 - Setnet Fleet and California Initiative 132

California setnet (gill net and trammel net) fishermen should be included in management of CPS because many have been landing small amounts of CPS (primarily for fresh fish markets). Many have expressed interest in catching more CPS now that Proposition 132 has displaced setnet fisheries in state waters.

Bramel and Kronman (1991) found it technically feasible to convert small gill net vessels to run with lampara nets for catching CPS. The average fixed cost of conversion (including gear, vessel and machinery modifications) was estimated to be \$16,400 without sonar and \$31,400 with sonar. By harvesting wetfish, a converted gill net boat could earn gross weekly revenues of \$1,500 to \$2,000.

In 1980, between 100 and 120 Vietnamese fishers and boat owners operated about 40 converted pleasure boats of the 20-30-foot range in the Monterey Bay area (Orbach and Beckwith 1980). The active Vietnamese fleet, however, comprised 40 to 60 fishers (in a single day as few as 3 to 15) who worked about 15 boats (in a single day as few as 1). The Vietnamese fleet used setnets to target white croaker (kingfish) and halibut.

In 1984, 586 setnet fishermen (95% of the total) held permits to operate from Point Sal to Point Reyes; 67% of these were traditional (non-Vietnamese), and 33% were Vietnamese (Ueber 1988). The traditional fleet was estimated to include 266 fishers who independently operated 133 vessels, about half of which used setnets. The traditional setnet fleet fished predominantly for Pacific halibut, rockfish, white croaker, shark, lingcod, and sablefish.

3.2.1 - Proposition 132 - Background

The use of setnets in commercial rockfish (i.e., Sebastes spp.) fisheries off California has become a source of heated conflict and political debate. In November 1990, California voters approved the Marine Resources Protection Act (Proposition 132), which bans the use of setnets to harvest rockfish in state waters (within 3 miles) off the California coast between Point Arguello in the Santa Barbara Channel and the Mexican border.

Proposition 132 also bars the use of setnets in waters shallower than 70 fathoms or within one mile around the Channel Islands, and in waters shallower than 35 fathoms between Point Fermin in Los Angeles County and Newport Beach in Orange County. In February 1991 CDFG petitioned the PFMC to determine whether Proposition 132 was consistent with the Pacific Coast Groundfish FMP (1982) and the MFCMA (1976). A determination of consistency would have extended the ban on setnets to the 200-mile limit of the U.S. EEZ. Before the PFMC considered the issue, California's attorney general determined that Proposition 132 applied to federal as well as state waters. An injunction by the United States District Court on April 2, 1991, prevented CDFG from enforcing the ban in federal waters off California. (PFMC 1991) In November 1991, PFMC determined that California Proposition 132 was inconsistent with MFCMA and the groundfish FMP. Although Proposition 132 was not extended to federal waters, most gill net fishing is done in state waters within 3 miles from shore, and therefore some gill and trammel net fishers unable to fish in deeper waters will be displaced from the rockfish fishery altogether.

Proposition 132 provides compensation to gill and trammel net fishermen who have declared intent to seek benefits within 90 days of the act's effective date. The deadline for application was February 4, 1991. CDFG notified the 557 general gill and trammel net permittees by mail, and 134 applied (Table 3.2.1-1.). Individual payments, to begin on July 1, 1993, "shall be based on average annual ex-vessel value of the fish other than any species of rockfish landed by (eligible) fishermen" from 1983 to 1987 (CDFG

1991b). Specific amounts to be awarded to setnet fishers had not been released by the time of this report.

Most of the 134 setnet fishers who are seeking compensation are in southern California (Table 3.2.1-1). Most (61%) of the applicants live in five of the six counties covered by the CPS plan (Los Angeles, Monterey, Orange, Santa Barbara and Ventura). Many applicants live in the community of San Pedro (20%) and in San Diego County (25%); a few live in Curry County, Oregon (1%), and Whatcom County, Washington (3%).

3.3 - Economic Impact of Commercial Fishery

Growth or decline in fishing affects production, trade and employment throughout the California economy, as fishers make purchases and as the fish are processed, distributed and marketed. Fishers' purchases can be categorized as fixed expenses (routine maintenance, insurance, moorage and debt service), trip expenses (ice, bait and fuel) and catch-related expenses (off-loading fees and crew shares). Revenues from these expenditures filter through local, state and regional economies. Directly and indirectly, commercial fishing in California generates approximately \$1 billion in annual sales for California businesses (ICF et al. 1988).

Economic multipliers are used to calculate change in production, income and employment resulting from a change in the level or the success of fishing. Economic multipliers for commercial wetfish seiners were estimated to increase California's output by \$3.80 and household income by \$1.10 per \$1.00 value of landings (ICF et al. 1988). California jobs were estimated to change by 82.9 per \$1 million value of wetfish landings.

Economic multipliers for California processing sectors were estimated for a range of manufacturing, trade and distribution of seafood products combined. Processing sectors contributed from \$1.60 (fish import and export brokers) to \$4.20 (smaller firms of wholesalers, processors and distributors) of California's output per \$1.00 of fish sales. Household income generated per \$1.00 of fish sales ranged from \$0.20 (fish import and export brokers) to \$0.90 (larger sized fish wholesalers, processors and distributors). California jobs were estimated to increase from 10.3 (fish import and export brokers) to 86.3 (larger sized fish wholesalers, processors and distributors) per \$1 million in fish sales.

The West Coast Fisheries Economic Assessment Model simulated the 1986 impacts in California from tuna (32,000 MT) and mackerel (53,000 MT) harvest combined to have generated \$1,278 average personal income per MT of fish landed (Radtke and Jensen 1987).

3.4 - Sources of Income for California Commercial Fishers

In 1984, 15% of California commercial fishers who operated trawl vessels and troll vessels earned all their income from fishing (ICF 1988). Another 66% earned more than half of their incomes from other occupations. Approximately one-third of trawlers and trollers held full-time shore-based jobs, and 30% held

part-time shore-based jobs or pooled their incomes with working spouses who held shore-based jobs. Commerical fishers who were retired from other occupations represented about 20% of those sampled; 17% survived on investment incomes; and an unreported percentage were part-time or full-time students.

3.5 - Recreational Fishery

Total participation in southern California sportfishing declined during 1980-89 from 2,408,000 to 1,390,000 anglers (Table 3.5-1). Coastal residents made up 70%-80% of total anglers; out-of-state residents made up 18%-25%; and noncoastal southern California residents made up only 1%-4%.

3.5.1 - Effort

Estimates of recreational fishing effort (number of trips) during 1980, 1985 and 1989 are provided in Table 3.5.1-1. Recreational trips declined from 9 million in 1980 to 4.6 million in 1989, although the figure for 1989 is an underestimate because pier fishing was not included in the preliminary data. Coastal residents made 89%-90% of all trips in all years; out-of-state anglers made 7%-9% of all trips and noncoastal residents made 1%-2%.

In 1980 pier fishing was most popular: 33% of sportfishing was done from man-made structures (Table 3.5.1-1). In 1985, private and rental boat fishing dominated (37%), and in 1989 bank (shore) fishing dominated (40%), although the 1989 data are hard to interpret, because pier fishing may have been included in the figures for shore fishing. Thomson and Crooke (1991) reported that 40% of recreational fishing in 1989 was done from private and rental boats.

3.5.2 - Expenditures

Table 3.5.2-1 lists 1989 recreational fishing expenditures by county of residence. The recreational fishery generated significant revenues through boat-related expenditures (moorage fees, insurance, etc.), expenditures on licenses and fishing gear, and trip-related expenditures. In 1989, \$536 billion was spent by local and visiting anglers in southern California, making recreational fishing an important contributor to local economies.

3.5.3 - Sociodemographics

Table 3.5.3-1 lists demographic characteristics for "key" anglers (the fisher who made the most trips in a household) in southern California sportfishing households during 1989. The key anglers were predominantly non-Hispanic white (85%) and male (91%) with median ages of 35 to 45 years. Hispanics made up 7% of total key anglers.

Seventy-four percent of anglers were employed for more than 35

hours per week; 11% were retired. A large proportion (41%) had some college education.

Most recreational fishing households had annual incomes in the range of \$30,000-\$40,000 (18%), with sizable fractions in the \$40,000-\$50,000 range (15%) and the \$20,000-\$30,000 range (13%).

3.5.4 - Motivation to Fish

Sixty-two to 74% of anglers among all four modes (beach, pier, CPFV and private/rental boat) went fishing to relax and "get away from it all" (Table 3.5.4-1). Other motivations were "fishing as a means to do something with family or friends," "fishing to please someone else," "fishing to put food on the table," "the availability of bait" and "the availability of target species."

3.5.5 - Bait Use

Table 3.5.5-1 lists the proportion of southern California sportfishing trips in 1989 for which CPS or squid were used as live or dead bait. Anchovy was the bait of choice for most trips except for beach fishing, and 35%-84% of recreational fishing trips used live or dead anchovy. Squid was frequently used, and Pacific mackerel and jack mackerel were moderately popular.

3.6 - Resource Use Conflicts

In the early 1980s controversy arose about how to allocate northern anchovy between sport and commercial fisheries (Huppert 1981; PMFC 1983). There was conflict over whether anchovy should be a commercial resource for reduction to fish meal and oil or forage and bait for sportfish.

Hook-and-line fishers operating from Santa Barbara and Morro Bay have expressed concern about the effects of oil exploration in the Santa Barbara Channel. Sound waves from geophysical survey devices used in oil exploration may startle marine fish (Malme et al. 1986; Pearson et al. 1987), affecting search time and catch per unit of effort in adjacent fisheries and decreasing efficiency. Experiments revealed that rockfish catch was substantially reduced during periods of sound transmission such as that used during oil exploration (Kearney/Centaur 1987a,b).

Fishers and seismic boats in the Santa Barbara Channel now maintain sufficient distance to avoid conflict. A NMFS source stated that seismic activity associated with oil exploration now has an insignificant effect on catch. But hook-and-line fishers from Santa Barbara and Morro Bay continue to encourage NMFS to study the effects of oil exploration.

3.7 - Profile - Los Angeles County

Most CPS economic activity takes place in Los Angeles County (Table 3.1-1). Harvesting, processing and support industries are located in San Pedro, Wilmington-Harbor City, and Long Beach.

3.7.1 - Population and Housing

From 1980 to 1990, the population of Los Angeles County increased from 7,477,503 to 8,897,500 (Table 3.7.1-1), from 1,800 persons per square mile to 2,200 persons per square mile. The number of housing units grew at about half the rate of population growth.

3.7.2 - Demographics

From 1980 to 1990 the number of whites in Los Angeles County declined from 68.7% to 56.8% of the total population, and blacks from 12.6% to 11.2%. People of Hispanic ethnic origin increased from 27.6% of the population to 37.8%. The numbers of Asians or Pacific Islanders grew 13.3% annually, from 5.5% in 1980 to 10.8% in 1990 (Table 3.7.1-1).

In 1980, 27.2% of the population was younger than 18 years; 62.9% was between 18 and 64 years; and 9.9% was older than 64. In 1990, the age structure remained virtually the same. The median age was 29.8 years in 1980 and 30.7 years in 1990 (Table 3.7.1-1).

3.7.3 - General Economy

The Los Angeles County civilian labor force averaged 3,545,000 in 1980 (47.4% of the total population) and 4,428,000 (50% of the population) in 1990 (Table 3.7.1-1). Unemployment was 6.6% in 1980 and 5.8% in 1990. Unofficial sources indicated that unemployment during 1991, a period of recession, exceeded 9%. Income per capita grew from \$17,743 in 1980 to \$19,906 in 1990 (Table 3.7.1-1).

Payrolls in the county grew continuously for most major industrial sectors from 1980 to 1988 (Table 3.7.3-1). Total payroll grew at an average annual rate of 3.3%, from \$73 billion to \$92 billion. Payroll growth was greatest (8.2% annually) in the services sector (from \$17 billion in 1980 to \$29 billion in 1988). Finance, insurance and real estate made up the second fastest-growing industrial sector, with 6.3% annual growth. Agriculture, forestry and fishing ranked third among major industries with 5.3% annual payroll growth.

In 1988, services (30.9%) and manufacturing (27.4%) made up the bulk of total payroll for Los Angeles County, although growth in the manufacturing sector was slow (Table 3.7.3-1). Finance, insurance and real estate (9.5%), retail trade (9.4%), wholesale trade (9.6%) and transportation and public utilities (7.3%) together made up a significant portion of the general payroll. Agriculture, forestry and fishing contributed a very small portion (0.3%) to total payrolls.

The number of persons employed in Los Angeles County grew 1.7% annually, from 3,184,578 workers in 1980 to 3,628,164 in 1988 (Table 3.7.3-2). Agriculture, forestry and fishing grew the most (5.4% annually), from 10,622 employees in 1980 to 15,223 in 1988 (at which time they represented 0.4% of county employees). The services sector sustained strong 4.7% annual increases from 815,283

people in 1980 to 1,124,051 in 1988, when they made up 31.0% of county employment. Wholesale trade employees increased 2.4% annually from 244,839 in 1980 to 290,919 in 1988. Positions in retail trades increased 2.1% annually from 532,703 jobs in 1980 to 622,070 in 1988, when they accounted for 17.2% of county employment. Even though manufacturing jobs decreased by 1.0% annually, they made up 24.6% of the county total in 1988.

3.7.4 - Earnings

Average 1988 earnings (payroll divided by number of employees) among the county's major industries were greatest in the mining sector (\$39,000; Table 3.7.3-3). Other jobs paying relatively well were transportation and public utilities, wholesale trade, construction and manufacturing.

3.7.5 - Maritime Economy

Seafood and related industrial subsectors of the 1988 Los Angeles County maritime economy (including the harvesting, processing, canning and curing, and wholesale and retail handling of fish; vessel building and repair; sporting goods sales; and amusement and recreation) accounted for 0.6% (\$535 million) of total annual payrolls and 0.6% (22,000) of total employees. From 1980 to 1988, payrolls in these areas grew by 3.6% annually, and employment grew by 1.1%. Vessel building and repair included work done for the Navy and the ocean transport industry. Sporting goods and recreational services also employed people in activities not related to fishing, so the data for these series in Tables 3.7.3-1, 3.7.3-2 and 3.7.3-3 overestimate the fishing industry's contributions.

Individual Los Angeles County maritime subsectors showed mixed economic performances. Payroll declined 8.7% annually for fishing, hunting and trapping, from \$35 million in 1980 to \$10 million in 1988 (Table 3.7.3-1). This decline was due largely to the 8.3% annual drops in numbers of employees from 823 in 1980 to 275 in 1988 (Table 3.7.3-2). Payroll for shipbuilding and boatbuilding and repair declined at 6.3% annually; employee numbers declined at 6.7% annually. Payroll for manufacturing of canned and cured seafood declined from \$96 million in 1975 to \$13 million in 1988 (data for 1980 not available). In Los Angeles County, amusement and recreation payrolls grew by 27.1% annually, from \$87 million in 1980 to \$276 million in 1988. The number of employees in this sector grew at a strong annual rate of 7.3%, increasing from 5,000 in 1980 to 8,000 in 1988. Payrolls in the wholesale fish and seafood subsector grew by 4.5% annually, and employees increased by 5.4%.

3.7.6 - Maritime Earnings

Although not uniquely dependent on the seafood industry, average earnings (payroll divided by number of employees) for Los

Angeles County in 1988 were highest (\$41 thousand) for those employed in shipbuilding and repair (Table 3.7.3-3). Fishers, hunters and trappers earned an average of \$38,000. Wholesale fish and seafood workers earned \$21,000; retail workers earned \$15,000. Those employed in manufacturing of prepared fresh and frozen fish earned an average of \$21,000. Persons employed to can and cure seafood earned an average of \$15,000.

3.8 - Community Profile - San Pedro, California

San Pedro is the single most important port for CPS in Los Angeles County. It is located in southwest Los Angeles on the southeastern slope of the Palos Verdes Peninsula. San Pedro was incorporated as an independent city in 1909 but annexed in 1988 by the City of Los Angeles. The community's roots developed over a century of participation in fishing and related industries and are described in the San Pedro Community Plan (Environmental Perspectives 1989). The community is small, with a hometown feeling, enhanced by the fact that many residents are employed locally.

The Fisherman's Fiesta has been the most visible community activity associated with fishing. Since its beginning in 1945, the fiesta has celebrated fishermen's role in the historical development of the San Pedro area. In October 1991 the fiesta was sponsored by 20 local organizations and drew thousands of people to Fishermen's Wharf to enjoy ethnic foods and entertainment. Sponsors included the Italian American Club, the Apostolic Church of San Pedro and Harbor City and the Los Angeles Police Department Explorers. The fiesta acknowledges the importance of religious ceremony to fishing with the blessing of the fleet.

3.8.1 - Population and Housing

Population in the San Pedro area grew from 62,336 in 1980 to 69,526 in 1990 (Table 3.8.1-1), and density increased from 9.6 persons per acre in 1980 to 11.4 in 1989. Total housing units in San Pedro increased from 25,053 in 1980 to 27,904 in 1990.

3.8.2 - Demographics

San Pedro's population is mostly white and non-Hispanic (59.7% of the total population in 1980 and 55.0% in 1990). Hispanics made up 30.8% of the population in 1980 and 34% in 1990; blacks made up 4.4% of the population in 1980 and 5% in 1990 (Table 3.8.1-1).

3.8.3 - Income, Employment and Poverty

San Pedro's mean household income during 1980 was \$29,829 (Table 3.8.1-1). Income earned from wages and salaries averaged \$22,362; self-employed income averaged \$1,884; income from interest and dividends averaged \$1,945; social security, \$1,544; and public assistance, \$472.

The civilian labor force in 1980 consisted of 27,303 people (43.8% of the total population) (Table 3.8.1-1). Of the total jobs, 35.5% (22,129) were manufacturing or service, 18.8% clerical, 10.9% professional, 9.6% sales, 9.1% management and administrative, 6.4% labor, 2.3% technical and 7.3% other.

In 1980, 8,500 people, or 13.6% of the total population, in San Pedro were below the poverty line (Table 3.8.1-1). Most of the impoverished people were younger than 55.

3.8.4 - History

For the purposes of this discussion, the commercial "wetfish" fleet for CPS in San Pedro comprises all vessels that landed any mackerel, anchovy or sardines in 1989. At that time the fleet employed purse seine, lampara, setnet, gill net and midwater trawl gears.

The San Pedro wetfish industry began in the early 1890s with the Alpha, a 22-ton sloop-rigged vessel skippered by Captain Young (Scofield 1951). Captain Young supplied sardines and mackerel to the area's first cannery, the California Fish Company, later renamed the Southern California Fish Company. The Alpha operated with a seven-man crew, making the first recorded California seine gear harvests in 1894. In addition to CPS, the Alpha landed yellowtail, barracuda and white sea bass, and generally supplied them to canneries rather than fresh fish markets.

The wetfish seine fleet grew as San Pedro shipbuilders added three new vessels from 1895 to 1914. The fleet remained small for nearly twenty years, until success at harvesting bluefin tuna led to a dramatic expansion of the fleet to 125 purse seine vessels by 1920. Some of the additional boats were built locally; others moved into the area from the northeast Pacific. By 1922 the operating fleet dwindled to 65 as many boats returned to the northeast Pacific or remained in port because of the poor post-World War I economy and reduced prices.

Southern California canneries grew at a rate parallel to that of the fishing fleet. The processing sector expanded first in San Pedro, after early experimentation with fish canning. Albacore tuna was first canned in 1911, and 16 tuna canneries had been established from San Pedro to San Diego by 1916. The capacity of the processing plants grew in response to the success of canned tuna, which also led to the processing of large amounts of mackerel and sardines.

The wetfish industry suffered from the sharp decline in sardine abundance from the mid 1940s through the 1960s. This was compounded in the 1970s by rising operating costs (primarily fuel) and static fish prices. Perrin and Noetzel (1970) found expansion or construction of new wetfish seiners economically infeasible, even with construction subsidies, because of catch rates and fish prices.

During the 1980s, the commercial fishing industry in Los Angeles continued to decline, directly affecting the local economies of San Pedro and Wilmington. One reason cited for the

decline was price-cutting competition from foreign fisheries, which allegedly operated with lower labor costs and government subsidies. State and local taxes and high insurance costs were blamed as additional burdens on the struggling industry. By 1986, only one fish packing plant remained of the 14 that constituted the industry in 1960. The business community dependent on San Pedro's revenue base was severely affected by job losses in the local fishery and related industries. The Terminal Island Star-Kist facility closure in October 1984 reportedly caused the loss of 1,200 jobs (California Legislature Senate Committee on Governmental Organization 1986).

3.8.5 - Residential Distribution of Crew Members

Zip codes on file with the AFL-CIO office in San Pedro are assumed to be representative of crew residence, although some fishermen may keep post office boxes near their work. According to Terry Hoinsky, Fisherman's Union representative, in 1991 the AFL-CIO represented 184 crewmen, or about 30% of the crew members who worked on vessels out of San Pedro.

Crew members resided primarily (89.0%) in the San Pedro area. Some (5.4%) lived in the surrounding communities of Wilmington, Lomita, Palos Verdes Peninsula and South Gate; others (3.2%) commuted from Carson, Van Nuys and Torrance.

3.8.6 - Crew Demography

Ethnicity and demographic data are available for commercial fishermen employed on six vessels that operated in the wetfish fishery during 1977, 1980, 1985 and 1990 (Table 3.8.6-1). These vessels employed between 102 and 71 crewmen annually over the time period. It was not possible to determine the ages for six crew members, but ethnicity data were available for all.

Italian crew members were the dominant ethnic group throughout the entire period and ranged from 54% to 63% of the total (Table 3.8.6-1). Yugoslavs ranged from 14% to 34% of the total crew and were the second most numerous group until 1990 when they were displaced by Hispanics. All six boats were owned by Italians, who may have employed Italian crew members because of cultural and familial ties.

The crew became younger over the first period, averaging 47 years in 1977 and 40 years in 1980 (Table 3.8.6-1). Average age increased during the remaining periods (45 years in 1985 and 49 years in 1990). Hispanic crew over the entire period were comparatively younger (30 to 42 years) than crew members from other ethnic groups, except for a single 27-year-old Portuguese in 1990. Ages for Italian crew ranged from 40 to 51 years and were equal to or greater than the median in all years.

Jacobson and Thomson (in press) indicate that changes in the ethnicity of crew members are due to different "opportunity costs" among traditional Italian and Yugoslav crew members and more recent participants who were mostly Hispanic. Declining economic

opportunities in the fishery may have contributed to the overall decline in crew members.

3.9 - Profile - Monterey County, California

Monterey represents the third most important region in terms of economic activity generated by the CPS fishery.

3.9.1 - Population and Housing

Total population in Monterey County was 290,444 in 1980, and it grew by 2.2% annually to 355,660 in 1990 (Table 3.9.1-1). Population density also increased by 2.2% annually, from 88 persons per square mile in 1980 to 107 in 1990. Available housing units grew at 1.7% annually, from 103,557 in 1980 to 121,224 in 1990.

3.9.2 - Demographics

From 1980 to 1990, the white population of Monterey County grew by 1.3% annually (Table 3.9.1-1). This rate was less than the county average. Hispanics increased by 5.9% annually, from 25.9% of the population in 1980 to 33.6% in 1990. Although the number of Asians and Pacific Islanders increased at an annual rate of 3.9%, they still represented only small segments of the population: 6.9% in 1980 and 7.8% in 1990. Although the black population grew at 1.9% annually, their proportion of the total population declined from 6.6% in 1980 to 6.4% in 1990. American Indians, Eskimos and Aleutian Islanders constituted 1.2% of the total population (3,550) in 1980 and 0.8% (3,017) in 1990, a decline of 1.5% annually.

In 1980, 28.3% (82,295) of Monterey County's population was younger than 18; 62.4% was between the ages of 18 and 64; and 9.2% were older than 64 (Table 3.9.1-1). By 1990, there had been no significant change. The median age in the county was 27.8 in 1980 and 29.6 in 1990.

3.9.3 - General Economy

The civilian labor force in Monterey County averaged 124,740 persons (42.9% of the population) in 1980, and 160,600 (45.2%) in 1990. The unemployment rate dropped from 9.1% in 1980 to 8.8% in 1990. Income per capita (in 1989 dollars) grew 0.8% annually, from \$16,427 in 1980 to \$17,622 in 1989.

The total county payroll (in 1989 dollars) grew at an annual rate of 3.5%, from \$1,135,000 in 1980 to \$1,548,000 in 1988 (Tables 3.9.3-1 and 3.9.3-2). Among Monterey's major industrial sectors, agriculture, forestry and fishing led in payroll growth (12.5% annually), rising from \$24 million in 1980 to \$48 million in 1988. Although this sector's growth was strong, it contributed only a small percentage (3.1% in 1988) to the total payroll. Service payrolls grew 8.1% annually, increasing from \$279 million in 1980 to \$459 million in 1988. Services represented the largest sector in 1988: 29.6% of total payroll. Transportation and public utilities

payrolls grew 5.7% per year, wholesale trade, 4.8% per year. Mild growth was posted in construction, manufacturing, finance, insurance and real estate, and retail trade. Both retail trade (19.3%) and manufacturing (15.2%) contributed significantly to the 1988 county payroll. In contrast, mining decreased from \$18 million in 1980 to \$2 million in 1988.

The total number of employees in Monterey County grew 2.8% annually, from 65,000 to 79,000 (Table 3.9.3-3). Agriculture, forestry and fishing grew the most: 10.0% annually, from 1,000 jobs in 1980 to 2,000 in 1988. Agriculture, forestry and fishing maintained 2.8% of the total employees in 1988. Service jobs grew at a strong annual rate of 5.1%, from 18,000 in 1980 to 25,000 in 1988, and in that year made up the largest percentage (32.1%) of county jobs. Moderate increases occurred in construction and transportation and utilities; less-than-average growth occurred in retail and wholesale trades.

3.9.4 - Earnings

Monterey County earnings (payroll divided by number of employees) in 1988 averaged \$20,000 (Table 3.9.4-1). Among major industrial sectors, mining paid the highest, averaging \$41,000. Strong earnings were made in wholesale trades; transportation and public utilities; construction; finance, insurance and real estate; and agriculture, forestry and fishing. Relatively weak earnings were made by those employed in service and retail trades.

3.9.5 - Maritime Economy

Monterey seafood and related industries (including sporting goods stores and amusement and recreation) accounted for 0.3% (\$5 million) of 1988 payrolls and 0.5% (434) of total employees (Table 3.9.3-3). Total maritime payrolls grew 4.1% per year, and number of employees grew 1.7% per year from 1980 to 1988. Sporting goods stores and bicycle shops posted 8.4% annual payroll growth, from \$1 million in 1980 to \$3 million in 1988, while jobs increased 9.6% annually. Amusement and recreation payrolls increased 2.7% per year, from \$2 million in 1980 to \$3 million in 1988; jobs increased by 1.2% per year. In 1986, manufacturing of prepared fresh and frozen fish contributed \$1 million to the county payroll and provided 196 jobs.

3.9.6 - Maritime Earnings

Monterey County maritime earnings averaged \$20,000 in 1988 (Table 3.9.4-1). Maritime earnings of those employed in sporting goods stores and bicycle shops were \$13,000 and in amusement and recreation were \$11,000. In 1986, jobs in the prepared fresh and frozen fish industry paid \$6,000.

3.9.7 - History---Commercial Fishery (Reinstedt 1978) Is this pamphlet a trust worthy document?

3.9.8 - Residential Distribution of Crew Members

The residential distribution of 128 crew members in the AFL-CIO Fisherman's Union who lived in Monterey County is described in Table 3.9.8-1: 79.7% (102) lived in the Monterey city area, and 11.7% in the Seaside area. Some came from Pacific Grove, Marina, King City and Carmel.

3.10 - Profile - Ventura County, California

Ventura County was, economically, the second most important region in the CPS fishery. Most CPS economic activity in Ventura County was centered in the Ventura city and Port Hueneme areas.

3.10.1 - Population and Housing

Population in Ventura County grew 2.6% annually, from 529,174 in 1980 to 669,016 in 1990 (Table 3.10.1-1). Population density increased from 284.0 persons per square mile to 362.4. The number of housing units grew by 2.5% annually, from 183,384 in 1980 to 228,478 in 1990.

3.10.2 - Demographics

From 1980 to 1990, whites made up the largest racial group, ranging from 80.4% (425,688) to 79.1% (529,166) of the county population (Table 3.10.1-1). Hispanics increased from 21.4% to 26.4%. Blacks made up about 2% of the population in 1980 and 1990.

The largest segment of Ventura's population--ages 18 to 64--grew slightly from 60.5% of the total population (320,367) in 1980 to 63.0% (423,025) in 1990 (Table 3.10.1-1). Although the number of people under 18 grew, the percentage declined from 31% 1980 to 27%. The percentage of people over 64 increased from 8.3% to 9.4%. This shift in the age structure was reflected in the county's median age, which climbed from 28.6 in 1980 to 31.7 in 1990.

3.10.3 - General Economy

Ventura County's civilian labor force averaged 232,800 (44% of the population) in 1980 and increased 6.1% annually, to 374,500 (56.0%) in 1990. In 1980 6.7% of the civilian labor force was unemployed; in 1990 5.5% was unemployed.. Income per capita grew 2.2% annually, from \$16,861 in 1980 to \$20,156 in 1989 (Table 3.10.1-1).

Total payroll for Ventura County grew 10.2% annually, from \$2,209,000 in 1980 to \$4,016,000 in 1988 (Table 3.10.3-1). Payroll growth was greatest in the retail (17.1%), service (15.6%) and transportation and public utilities (14.5%) sectors.

In 1988, most Ventura County payrolls were in services (27.6%), manufacturing (24.1%) and retail trade (14.2%) (Table 3.10.3-1). Agriculture, forestry and fishing contributed 1.0% (\$38 million) to county payrolls in 1988.

Total countywide employment grew 7.4% annually from 1980 to 1988. The greatest growth was in the mining sector (an astounding 132% annual rate). Growth in the service and construction sectors was 11%, and in transportation and public utilities, 10% annually. Employment in agriculture, forestry and fishing was 1.5% of the county total.

3.10.4 - Earnings

In 1988, Ventura County earnings (payroll divided by employees) were highest for manufacturing employees (\$29,000). Employees in transportation and public utilities earned an average of \$28,000; mining, \$27,000; wholesale trade, \$27,000; and agriculture, forestry and fisheries, \$13,000.

3.10.5 - Maritime Economy

Maritime real payrolls (including processing, canning and curing, retail handling of fish, vessel building and repair, sporting goods stores, and amusement and recreation) accounted for 0.3% (\$9,859,000) of the 1988 county total (Table 3.10.3-1). Sporting goods stores and bicycle shops posted a total payroll of \$4,091,000; amusement and recreation, \$1,681,000; and retail meat and fish sales, \$1,312,000.

From 1980 to 1988 Ventura County maritime payroll growth was greatest for those employed in sporting goods stores (7.5%). Payrolls declined in amusement and recreation (7% annually), and mining (1% annually).

Maritime employees in 1988 represented 0.5% (959) of the Ventura County total (Table 3.10.5-1). In 1988, sporting goods stores and bicycle shops employed 0.2% of total county employees; manufacturing of prepared fresh and frozen fish supported 0.1% of county workers; amusement and recreation supported 0.1%; retail meat and fish (seafood) supported 0.1%; and boatbuilding and repair less than 0.1%.

3.10.6 - Maritime Earnings

In 1988, earnings (payroll in 1989 dollars divided by employees) among maritime industries averaged \$10,000 and were greatest for employees in boatbuilding and repair (\$19,000). Those employed in meat and fish (seafood) retail markets made \$12,000; sporting goods stores, \$11,000; and prepared fresh and frozen fish, \$8,000.

Table 3.1-1. Total landings (mt), revenues (\$1000, 1989 dollars), trips, and vessels (by size class) for coastal pelagic species (anchovy, mackerel, and sardines) during 1986 to 1989. Data from PacFIN Research Database.

County	Size	NVessel	NTrips	MTons	Revenue	Rev/Boat
San Diego	<50	72	956	81.59	\$138.70	\$1.93
	50 to 100	4	40	58.59	\$22.55	\$5.64
	>100	1	2	2.18	\$0.00	\$0.00
	Total	77	998	142.36	\$161.25	\$2.09
LA/Orange	<50	153	3,504	25,506.77	\$4,466.51	\$29.19
	50 to 100	41	5,272	175,499.10	\$33,604.97	\$819.63
	Total	194	8,776	201,005.87	\$38,071.48	\$196.24
Ventura/St. Barabara	<50	60	991	18,247.83	\$2,641.67	\$44.03
	50 to 100	9	412	4,139.74	\$716.84	\$79.65
	Total	69	1,403	22,387.57	\$3,358.51	\$48.67
San Luis Obispo	<50	10	47	25.41	\$7.67	\$0.77
Monterey/St. Cruz	<50	89	1,160	4,325.80	\$943.72	\$10.60
	50 to 100	5	64	1,397.04	\$131.45	\$26.29
	Total	94	1,224	5,722.84	\$1,075.17	\$11.44
San Francisco Bay Area	<50	87	478	46.53	\$22.41	\$0.26
	50 to 100	7	401	2,061.80	\$495.06	\$70.72
	Total	94	879	2,108.33	\$517.47	\$5.51
Marin/Sonoma	<50	9	41	2.35	\$2.31	\$0.26
	50 to 100	3	6	0.32	\$0.17	\$0.06
	Total	12	47	2.67	\$2.48	\$0.21
Mendocino	50 to 100	1	1	0.05	\$0.02	\$0.02
Humboldt	<50	1	1	0.05	\$0.05	\$0.05
Oregon State	<50	27	79	2.72	\$0.62	\$0.02
	50 to 100	3	3	2.45	\$0.45	\$0.15
	Total	30	82	5.17	\$1.07	\$0.04
Washington State	<50	4	92	201.93	\$170.74	\$42.69
	50 to 100	1	1	0.11	\$0.02	\$0.02
	Total	5	93	202.04	\$170.76	\$34.15
Total		587	13,551	231,602.36	\$43,365.93	\$73.88

Table 3.1-2. Total landings (mt), revenues (\$1000, 1989 dollars), trips, and vessels (by size class) for roundhal vessels (anchovy, mackerel, and sardines) during 1986 to 1989. Data from PacFIN Research Database.

County	Size	NVessel	NTrips	MTons	Revenue	Rev/Boat
San Diego	<50	36	556	54.69	\$112.68	\$3.13
	50 to 100	1	32	57.71	\$21.91	\$21.91
	Total	37	588	112.40	\$134.59	\$3.64
LA/Orange	<50	90	2,700	24,866.93	\$4,317.76	\$47.98
	50 to 100	36	5,245	175,198.10	\$33,562.11	\$932.28
	Total	126	7,945	200,065.03	\$37,879.87	\$300.63
Ventura/St. Barbara	<50	40	860	18,038.81	\$2,554.11	\$63.85
	50 to 100	9	412	4,139.74	\$716.84	\$79.65
	Total	49	1,272	22,178.55	\$3,270.95	\$66.75
San Luis Obispo	<50	6	34	24.54	\$7.36	\$1.23
Monterey/St. Cruz	<50	47	1,012	4,318.41	\$940.69	\$20.01
	50 to 100	1	51	1,357.76	\$126.52	\$126.52
	Total	48	1,063	5,676.17	\$1,067.21	\$22.23
San Francisco Bay Area	<50	44	281	31.73	\$10.76	\$0.24
	50 to 100	2	390	2,059.15	\$493.56	\$246.78
	Total	46	671	2,090.88	\$504.32	\$10.96
Washington State	<50	3	91	201.89	\$170.72	\$56.91
Total		315	11,664	230,349.46	\$43,035.02	\$136.62

Table 3.2.1-1. Geographic distribution of setnet fishers (preliminary list) who may receive compensation under California Proposition 132.

County	Number	Percent
Curry, Oregon	1	1%
Los Angeles	33	25%
-San Pedro	27	20%
Monterey	1	1%
Orange	3	2%
Riverside	1	1%
San Diego	34	25%
San Luis Obispo	8	6%
San Mateo	1	1%
Santa Barbara	24	18%
Santa Clara	1	1%
Santa Cruz	0	0%
Sonoma	1	1%
Ventura	20	15%
Whatcom	4	3%
Other	2	1%
Total	134	100%

Source: Don Schultz, CDFG, Sacramento

Table 3.5-1. Estimated number of marine recreational fishers (thousands) in southern California^a

Residence of Participant	1980		1985		1989	
	Number	Percent	Number	Percent	Number	Percent
Coastal ^b	1,710	71.0%	994	71.6%	1,119	80.5%
Noncoastal	91	3.8%	50	3.6%	20	1.4%
Out of state	607	25.2%	344	24.8%	250	18.1%
Total	2,408	100.0%	1,388	100.0%	1,390	100.0%

^a Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara and Ventura counties.
^b Within 25 miles of the coast.

Sources: Department of Commerce, NOAA, NMFS, Marine Recreational Fishing Statistical Survey. Reports Nos. 8321 and 8328 and 1989 tables (Washington, D.C.: 1984, 1986 and 1989).

Table 3.5.1-1. Estimated number of marine recreational fishing trips (thousands) in southern California^a during 1980, 1985 and 1989 by mode and residence

Mode	1980					
	Coastal ^b		Noncoastal		Out-of-State	
	Percent		Percent		State	Percent
Pier ^c	30.2%	2,700	0.7%	203	2.3%	2,962
Bank ^d	17.2%	1,540	0.5%	160	1.8%	1,745
CPFV ^e	15.6%	1,392	0.4%	274	3.1%	1,699
Pvt. ^f	26.5%	2,371	0.6%	116	1.3%	2,540
Total	89.5%	8,003	2.2%	753	8.5%	8,946
						100.0%

Mode	1985					
	Coastal		Noncoastal		Out-of-State	
	Percent		Percent		State	Percent
Pier	24.3%	1,284	0.5%	104	2.0%	1,415
Bank	12.4%	654	0.4%	68	1.3%	743
CPFV	17.9%	947	0.4%	186	3.5%	1,152
Pvt	34.6%	1,826	0.8%	98	1.9%	1,967
Total	89.2%	4,711	2.1%	456	8.7%	5,277
						100.0%

Mode	1989					
	Coastal		Noncoastal		Out-of-State	
	Percent		Percent		State	Percent
Pier	37.5%	1,744	0.4%	89	1.9%	1,852
Bank	20.2%	937	0.3%	180	3.9%	1,133
CPFV	34.2%	1,590	0.4%	50	1.1%	1,660
Pvt	91.9%	4,271	1.2%	319	6.9%	4,645
Total						100.0%

^a Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara and Ventura Counties.

^b Within 25 miles of the coast.

^c Structures such as piers, docks, jetties, breakwaters, breachways, bridges and causeways.

^d Beaches and banks.

^e Party and charter boats.

^f Private and rental boats.

Sources: Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, MRFSS, Reports Nos. 8321, 8328, (Washington, D.C.:1984 and 1986) and 1989 data tables.

Table 3.5.2-1. Total annual expenditures for saltwater fishing (\$1,000's), by expenditure category and county of residence

County of Residence	Licenses & Gear	Boat-Related Expenditures	Trip-Related Expenditures					Grand Total
			Beach	Pier	CPFV	Private Boat	Total	
Los Angeles	35,765.6	27,106.1	3,275.2	10,240.0	80,960.1	40,709.0	135,184.4	198,056.1
Orange	14,914.9	39,551.8	1,888.7	2,576.6	31,296.0	27,963.0	63,724.3	118,191.0
Riverside	2,660.5	2,203.1	281.4	1,309.2	8,526.8	4,752.7	14,870.1	19,733.7
San Bernardino	3,077.6	4,010.9	46.6	1,915.6	6,016.3	5,191.6	13,170.0	20,258.5
San Diego	13,101.2	19,490.7	4,614.8	3,801.2	15,959.0	19,095.2	43,470.3	76,062.2
San Luis Obispo	1,156.9	1,037.4	492.4	462.1	2,454.3	1,953.1	5,361.9	7,556.2
Santa Barbara	1,719.1	2,473.4	1,256.6	894.6	1,210.9	3,893.0	7,255.1	11,447.6
Ventura	3,018.5	5,544.7	908.6	1,340.3	6,817.0	5,267.4	14,333.3	22,896.5
Noncoastal	12,678.3	18,967.1	3,532.3	5,163.3	14,752.3	6,965.5	30,413.4	62,058.8
Total	88,092.7	120,385.2	16,296.6	27,703.0	167,992.7	115,790.6	327,782.8	536,260.6

Source: Thomson and Crooke 1991.

Table 3.5.3-1. Demographics of southern California anglers, 1989, by county of residence

	LA	Orange	River	San Bern	San D	San L Ob	San B	Vent	Other	Average
<u>Age</u>										
1-12	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.1%
13-16	0.2%	2.0%	2.3%	1.0%	1.0%	2.8%	2.0%	1.8%	2.4%	1.8%
17-24	10.4%	9.0%	9.7%	8.2%	14.9%	8.8%	11.4%	7.7%	12.9%	10.3%
25-34	31.8%	31.3%	27.3%	28.2%	30.8%	28.9%	22.9%	28.1%	18.8%	27.6%
35-44	23.7%	26.4%	36.4%	32.8%	22.9%	24.5%	33.8%	26.7%	21.2%	27.6%
45-54	16.8%	15.9%	13.6%	15.9%	14.9%	14.9%	13.4%	19.5%	25.9%	16.8%
55-64	9.2%	10.4%	5.7%	8.7%	9.0%	8.4%	7.0%	10.0%	10.6%	8.8%
>64	5.0%	5.1%	5.1%	6.5%	11.6%	9.0%	6.3%	6.3%	8.2%	7.0%
Male	91.3%	92.1%	90.4%	90.8%	88.6%	88.4%	92.1%	92.3%	90.6%	90.7%
<u>Ethnicity</u>										
Asian/Pac	5.1%	3.9%	2.2%	2.0%	5.4%	1.6%	3.9%	3.1%	0.0%	3.0%
Black	6.3%	0.0%	1.7%	3.5%	1.5%	0.4%	1.0%	1.3%	1.2%	1.9%
Hispanic	10.8%	7.8%	4.5%	7.5%	3.5%	6.5%	8.8%	7.6%	5.9%	7.0%
Non-Hisp	77.3%	86.3%	88.2%	82.4%	86.1%	89.5%	83.9%	85.7%	89.4%	85.4%
Other	0.6%	2.0%	3.4%	4.5%	3.5%	2.0%	2.4%	2.2%	3.5%	2.7%
<u>Employment Status</u>										
<35 h/wk	75.1%	77.8%	79.1%	73.5%	74.4%	66.5%	68.0%	75.0%	76.7%	74.0%
>35 h/wk	4.5%	4.3%	4.0%	7.5%	6.4%	7.5%	4.9%	4.5%	1.2%	5.0%
Retired	10.2%	6.3%	7.9%	9.0%	9.9%	15.0%	12.1%	11.6%	15.1%	10.8%
Student	5.6%	4.3%	3.4%	3.5%	3.9%	6.3%	8.7%	1.8%	3.5%	4.6%
Homemaker	1.1%	2.4%	1.7%	0.5%	1.5%	1.2%	1.0%	0.4%	2.3%	1.3%
Unemployed	0.0%	0.0%	1.1%	2.0%	1.0%	0.8%	2.4%	1.8%	0.0%	1.0%
Other	3.4%	4.8%	2.8%	4.0%	3.0%	2.8%	2.9%	4.9%	1.2%	3.3%

Table 3.5.3-1 (cont.)

Education

	LA	Orange	River	San Bern	San D	San L	Ob	St	B	Vent	Other	Average
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Less than 8th grade	1.7%	0.5%	1.7%	1.5%	0.0%	0.8%		0.5%	0.0%	0.0%	0.0%	0.7%
8th grade graduate	2.8%	0.5%	0.0%	0.0%	1.0%	0.4%		0.5%	1.3%	2.3%		1.0%
Some high school	5.1%	4.3%	9.0%	4.5%	3.4%	6.7%		6.3%	3.1%	7.0%		5.5%
High school graduate	17.0%	11.1%	15.7%	15.6%	10.8%	13.8%		16.5%	12.1%	17.4%		14.4%
Some trade school	7.4%	3.4%	2.8%	4.5%	3.9%	1.6%		4.9%	4.9%	8.1%		4.6%
Trade/technical school graduate	5.7%	4.8%	4.5%	9.0%	5.9%	7.5%		6.8%	7.2%	4.7%		6.2%
Some college	34.1%	40.6%	43.8%	42.7%	44.8%	41.7%		37.9%	43.0%	38.4%		40.8%
BA	15.3%	15.9%	11.2%	10.1%	18.2%	14.6%		15.5%	14.8%	11.6%		14.1%
Postgraduate	10.8%	18.8%	11.2%	12.1%	11.8%	13.0%		11.2%	13.5%	10.5%		12.5%

Annual Household Income

	LA	Orange	River	San Bern	San D	San L	Ob	St	B	Vent	Other	Average
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
<10k	2.5%	1.0%	2.9%	2.7%	3.2%	5.8%		7.3%	1.4%	2.5%		3.3%
10-20k	11.9%	4.1%	5.8%	9.6%	9.5%	14.5%		9.3%	2.4%	12.3%		8.8%
20-30k	13.1%	9.8%	13.5%	11.8%	15.8%	17.4%		14.5%	11.4%	13.6%		13.4%
30-40k	13.1%	17.4%	12.9%	16.6%	16.8%	22.0%		18.7%	18.6%	24.7%		17.9%
40-50k	15.6%	14.9%	21.1%	17.1%	13.7%	15.8%		11.4%	17.1%	12.3%		15.4%
50-60k	12.5%	9.8%	12.3%	14.4%	10.5%	10.0%		13.5%	13.3%	11.1%		11.9%
60-70k	7.5%	13.9%	9.4%	8.0%	10.5%	4.1%		8.3%	10.0%	7.4%		8.8%
70-80k	4.4%	6.7%	9.9%	7.5%	7.9%	2.9%		6.7%	6.7%	8.6%		6.8%
80-90k	5.0%	6.7%	3.5%	3.7%	2.6%	2.9%		2.6%	6.7%	3.7%		4.2%
90-100k	2.5%	2.1%	2.3%	2.1%	1.6%	0.4%		1.6%	2.9%	0.0%		1.7%
100-110k	3.1%	2.6%	2.3%	2.7%	2.1%	0.4%		1.6%	3.3%	1.2%		2.1%
110-120k	1.3%	2.6%	1.2%	1.6%	0.5%	1.2%		0.5%	1.4%	0.0%		1.1%
120-130k	1.9%	3.1%	0.0%	0.0%	3.2%	0.0%		1.0%	1.0%	1.2%		1.3%
130-140k	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.5%	0.0%		0.1%
>140k	5.0%	5.2%	2.9%	2.1%	2.1%	2.5%		3.1%	3.3%	1.2%		3.0%
Sample	160	194	171	187	190	241		193	210	81		
Total												100.0%

Source: Thomson and Crooke 1991.

Table 3.5.4-1. Motivation for fishing for southern California anglers in 1989, by mode, on a scale of 1 (not at all important) to 7 (very important)

Scale	Beach						
	Food	Challenge	Fish	Bait	Relax	Social	Please
1	51.7%	2.0%	34.5%	60.6%	0.7%	5.5%	81.4%
2	8.3%	0.7%	8.3%	9.9%	1.3%	4.1%	4.8%
3	13.8%	2.7%	9.0%	7.0%	2.0%	2.1%	2.8%
4	13.8%	12.2%	17.2%	8.5%	1.3%	10.3%	5.5%
5	6.2%	8.2%	9.0%	4.9%	6.0%	11.0%	1.4%
6	1.4%	17.7%	11.7%	2.1%	14.8%	13.1%	0.7%
7	4.8%	56.5%	10.3%	7.0%	73.8%	53.8%	3.4%
	(151)	(147)	(145)	(142)	(149)	(145)	(145)

Pier							
1	70.3%	4.2%	51.9%	64.3%	0.9%	3.8%	67.5%
2	9.0%	0.0%	9.0%	8.9%	0.9%	1.9%	6.7%
3	7.1%	3.3%	9.4%	8.0%	2.3%	1.9%	3.8%
4	7.1%	14.0%	11.8%	7.0%	7.0%	7.5%	4.8%
5	0.9%	19.2%	8.0%	3.3%	10.3%	9.9%	4.3%
6	1.4%	14.5%	2.8%	2.8%	16.8%	19.2%	2.9%
7	4.2%	44.9%	7.1%	5.6%	61.7%	55.9%	10.0%
	(212)	(214)	(212)	(213)	(214)	(213)	(209)

CPFV							
1	49.8%	2.0%	24.9%	47.5%	2.1%	2.1%	73.5%
2	14.8%	1.7%	7.1%	13.7%	1.1%	0.9%	7.0%
3	11.8%	2.5%	9.2%	9.9%	2.1%	3.4%	4.1%
4	12.1%	10.7%	14.9%	9.7%	6.5%	10.1%	5.1%
5	4.7%	16.1%	13.7%	6.0%	10.9%	14.1%	2.8%
6	2.7%	13.5%	9.8%	3.6%	15.1%	22.1%	3.2%
7	4.1%	53.6%	20.4%	9.6%	62.2%	47.2%	4.5%
	(703)	(713)	(706)	(699)	(709)	(701)	(690)

Private Boat							
1	49.0%	3.1%	25.2%	52.0%	1.1%	1.4%	73.3%
2	11.1%	0.5%	5.6%	8.5%	0.7%	1.1%	6.5%
3	12.3%	3.6%	10.4%	8.7%	2.0%	2.9%	5.2%
4	14.6%	9.0%	15.7%	13.3%	6.4%	7.7%	6.7%
5	7.7%	17.0%	13.9%	6.0%	9.6%	13.2%	2.7%
6	1.8%	15.4%	7.4%	2.8%	14.3%	17.6%	3.1%
7	3.5%	51.3%	21.8%	8.7%	66.0%	56.1%	2.5%
	(569)	(577)	(568)	(565)	(561)	(561)	(554)

Food=Fishing gives me the opportunity to put food on the table.
 Challenge=I enjoy the challenge of catching fish.
 Fish=A species that I particularly like to fish for was available at this time.
 Bait=A bait that I like to fish with was available at this time.
 Relax=Fishing gives me the opportunity to relax and "get away from it all."
 Social=Fishing gives me the opportunity to do something with family and/or friends.
 Please=I went fishing to please someone else.

Source: Thomson and Crooke, 1991.

Table 3.5.5-1. Bait used by southern California anglers, during 1989, by fishing mode

Bait	Fishing Mode			
	Beach	Pier	CPFV	Private Boat
Anchovy	34.5%	66.4%	84.2%	71.1%
Live	2.7%	12.3%	76.5%	43.9%
Dead	33.1%	59.5%	13.4%	33.5%
Squid	31.1%	43.6%	50.6%	43.4%
Live	0.7%	0.5%	18.1%	7.6%
Dead	30.4%	43.2%	37.4%	37.0%
Pac. Mackerel	6.1%	27.3%	15.4%	17.3%
Live	0.0%	3.2%	9.2%	8.8%
Dead	6.1%	25.9%	7.3%	9.7%
Jack Mackerel	2.0%	9.5%	3.8%	4.4%
Live	0.7%	3.6%	2.0%	2.5%
Dead	1.4%	6.4%	1.8%	2.1%
Sardine	2.7%	6.8%	9.8%	5.1%
Live	0.0%	0.9%	8.4%	3.2%
Dead	2.7%	6.4%	2.0%	1.9%
Other fish	42.6%	23.2%	6.6%	8.5%
Live	25.7%	10.5%	4.1%	4.6%
Dead	19.6%	13.2%	2.7%	4.6%
Artificial Lures	27.0%	35.9%	38.1%	50.4%
Total trips	148	220	714	567

Many anglers used more than one type of bait per trip, so figures in columns do not sum to 100%.

Source: Thomson and Crooke (1991).

Table 3.7.1-1. Socioeconomic profile for Los Angeles County, 1980-1990. Data for 1980 from Kearny/Centaur (1987a). Data for 1990 from Bureau of the Census (1991) and California Employment Development Department, Labor Information Division (personal communication). All dollar values are corrected for inflation and expressed in 1989 dollars. "Asian or Pacific Islander" includes persons who reported themselves as "Chinese," "Filipino," "Japanese," "Asian Indian," "Korean," "Vietnamese," "Other Asian," "Hawaiian," "Samoan," or "Other Pacific Islander." Note that "Hispanic" denotes an ethnic group not a racial group. Racial group statistics are given for the whole population and non-hispanic population. Statistics by racial group for hispanics can be obtained by subtraction (e.g. population of white hispanics in 1990 was 5,035,103 - 3,618,850).

	1980		1990		Annual Change
	Number	Percent	Number	Percent	
Population	7,477,503	100.0%	8,863,164	100.0%	1.9%
Population Density (persons/square mile)	1,800		2,200		2.2%
Entire Population by Racial Group					
-White	5,135,540	68.7%	5,035,103	56.8%	-0.2%
-Black	943,124	12.6%	992,974	11.2%	0.5%
-American Indian, Eskomo or Aleut					
-Asian or Pacific Islander	53,542	0.7%	45,508	0.5%	-1.5%
-Other race	408,876	5.5%	954,485	10.8%	13.3%
	20,565	0.3%	1,835,094	20.7%	882.3%
Hispanic Origin all Races	2,063,791	27.6%	3,351,242	37.8%	6.2%
Non-Hispanic Population by Racial Group					
-White			3,618,850	40.8%	
-Black			934,776	10.5%	
-American Indian, Eskomo or Aleut			29,159	0.3%	
-Asian or Pacific Islander			907,810	10.2%	
-Other race			21,327	0.2%	
Age					
-Under 18	2,033,881	27.2%	2,326,110	26.2%	1.4%
-18 to 64	4,703,349	62.9%	5,676,467	64.0%	2.1%
-65 and older	740,273	9.9%	860,587	9.7%	1.6%
-Median age	29.8		30.7		0.3%
All Housing Units	2,855,555	38.2%	3,163,343	35.7%	1.1%
Avg. Civilian Labor Force	3,545,000	47.4%	4,427,800	50.0%	2.5%
Civilian Unemployment Rate	6.6%		5.8%		-1.2%
Per Capita Income	\$17,743		\$19,906		1.4%

Table 3.7.3-1. Annual payroll (in thousands of 1989 dollars) for Los Angeles County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1977, 1982, 1987, 1988, 1989, 1990). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1975	1980	1985	1986	1987	1988
Total Annual Payroll	\$55,833,941	\$73,189,138	\$81,841,333	\$85,110,428	\$86,236,401	\$92,791,371
Maritime Total	\$429,959	\$415,893	\$332,667	\$351,185	\$371,413	\$496,458
Agricultural Services, Forestry and Fishing						
- Fishing, Hunting and Trapping	\$123,508	\$191,321	\$218,747	\$241,487	\$250,510	\$272,341
- Other	\$43,648	\$34,806	\$12,990	\$11,365	\$13,081	\$10,472
	\$79,860	\$156,514	\$205,758	\$230,122	\$237,429	\$261,869
Mining	\$28,380	\$350,043	\$304,508	\$251,319	\$218,491	\$248,244
Construction	\$3,375,326	\$4,192,140	\$3,857,132	\$3,876,947	\$3,768,249	\$4,128,082
Manufacturing						
- Canned and Cured seafoods	\$19,762,103	\$24,020,507	\$24,951,474	\$25,403,547	\$25,295,156	\$25,421,160
- Prepared Fresh and Frozen Fish	\$95,851	D	D	D	D	\$12,957
- Ship and Boat Building and Repair	\$13,761	\$23,418	\$26,060	\$29,717	\$29,662	\$34,809
- Ship Building and Repair	\$139,133	\$170,130	\$128,615	\$127,123	\$107,429	\$84,614
- Boat Building and Repair	\$119,710	\$148,750	D	D	D	\$66,163
- Other	\$19,296	\$21,380	D	D	D	\$18,451
	\$19,513,358	\$23,826,959	\$24,796,799	\$25,246,707	\$25,158,065	\$25,288,781
Transportation and Public Utilities	\$5,077,560	\$5,910,853	\$6,117,833	\$6,149,958	\$1,659,271	\$6,744,651
Wholesale Trade	\$5,246,221	\$6,786,725	\$7,590,328	\$7,786,614	\$8,272,971	\$8,883,183
- Fish and Seafood	\$16,147	\$25,847	\$21,717	\$31,673	\$41,881	\$35,158
- Other	\$5,230,074	\$6,760,878	\$7,568,611	\$7,754,941	\$8,231,090	\$8,848,025
Retail Trade	\$6,458,951	\$7,665,416	\$8,313,209	\$8,490,231	\$8,692,728	\$8,751,380
- Meat and Fish (seafood) Markets	\$31,148	\$27,515	D	D	D	\$25,457
- Sporting Goods Stores and Bicycle Shops	\$38,228	\$47,049	\$47,037	\$52,507	\$52,407	\$55,633
- Other	\$6,389,575	\$7,590,852	\$8,266,172	\$8,437,724	\$8,640,321	\$8,670,291
Finance, Insurance and Real Estate	\$3,721,699	\$5,868,249	\$7,212,001	\$7,884,170	\$8,740,199	\$8,820,890
Services						
- Amusement and Recreation	\$11,379,133	\$17,311,456	\$22,494,157	\$24,223,863	\$2,765,049	\$28,707,116
- Other	\$52,044	\$87,127	\$96,248	\$98,800	\$126,954	\$275,772
	\$11,327,090	\$17,224,329	\$22,397,909	\$24,125,063	\$2,638,095	\$28,431,344

Table 3.7.3-2. Annual Payroll (\$1000, 1989 dollars), 1988 Payroll composition and 1980 to 1988 annual percent changes by industry for Los Angeles County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1990). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1980	1988	1988 %	% change
Total Annual Payroll	\$73,189,138	\$92,791,371	100.0%	3.3%
Maritime Total	\$415,893	\$534,872	0.6%	3.6%
Agricultural Services, Forestry and Fishing	\$191,321	\$272,341	0.3%	5.3%
- Fishing, Hunting and Trapping	\$34,806	\$10,472	0.0%	-8.7%
- Other	\$156,514	\$261,869	0.3%	8.4%
Mining	\$350,043	\$248,244	0.3%	-3.6%
Construction	\$4,192,140	\$4,128,082	4.4%	-0.2%
Manufacturing	\$24,020,507	\$25,421,160	27.4%	0.7%
- Canned and Cured seafoods	D	\$12,957	0.0%	
- Prepared Fresh and Frozen Fish	\$23,418	\$34,809	0.0%	6.1%
- Ship and Boat Building and Repair	\$170,130	\$84,614	0.1%	-6.3%
- Ship Building and Repair	\$148,750	\$66,163	0.1%	-6.9%
- Boat Building and Repair	\$21,380	\$18,451	0.0%	-1.7%
- Other	\$23,826,959	\$25,288,781	27.3%	0.8%
Transportation and Public Utilities	\$5,910,853	\$6,744,651	7.3%	1.8%
Wholesale Trade	\$6,786,725	\$8,883,183	9.6%	3.9%
- Fish and Seafood	\$25,847	\$35,158	0.0%	4.5%
- Other	\$6,760,878	\$8,848,025	9.5%	3.9%
Retail Trade	\$7,665,416	\$8,751,380	9.4%	1.8%
- Meat and Fish (seafood) Markets	\$27,515	\$25,457	0.0%	-0.9%
- Sporting Goods Stores and Bicycle Shops	\$47,049	\$55,633	0.1%	2.3%
- Other	\$7,590,852	\$8,670,291	9.3%	1.8%
Finance, Insurance and Real Estate	\$5,868,249	\$8,820,890	9.5%	6.3%
Services	\$17,311,456	\$28,707,116	30.9%	8.2%
- Amusement and Recreation	\$87,127	\$275,772	0.3%	27.1%
- Other	\$17,224,329	\$28,431,344	30.6%	8.1%

Table 3.7.3-4. Real payroll (1989 dollars, \$1,000), number of employees, and real payroll per employee by industry for Los Angeles County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1990). Excludes government employees, railroad employees and self employed persons.

	1988 pay	1988 emp	pay/emp
Total	\$92,791,371	3,628,164	\$26
Maritime Total	\$534,872	22,143	\$24
Agricultural Services, Forestry and Fishing	\$272,341	15,223	\$18
- Fishing, Hunting and Trapping	\$10,472	275	\$38
- Other	\$261,869	14,948	\$18
Mining	\$248,244	6,369	\$39
Construction	\$4,128,082	143,395	\$29
Manufacturing	\$25,421,160	891,105	\$29
- Canned and Cured seafoods	\$12,957	848	\$15
- Prepared Fresh and Frozen Fish	\$34,809	1,656	\$21
- Ship and Boat Building and Repair	\$84,614	2,596	\$33
- Ship Building and Repair	\$66,163	1,631	\$41
- Boat Building and Repair	\$18,451	965	\$19
- Other	\$25,288,781	886,005	\$29
Transportation and Public Utilities	\$6,744,651	219,815	\$31
Wholesale Trade	\$8,883,183	290,919	\$31
- Fish and Seafood	\$35,158	1,658	\$21
- Other	\$8,848,025	289,261	\$31
Retail Trade	\$8,751,380	622,070	\$14
- Meat and Fish (seafood) Markets	\$25,457	2,218	\$11
- Sporting Goods Stores and Bicycle Shops	\$55,633	4,603	\$12
- Other	\$8,670,291	628,891	\$14
Finance, Insurance and Real Estate	\$6,745,340	285,731	\$24
Services	\$28,707,116	1,124,051	\$26
- Amusement and Recreation	\$275,772	8,289	\$33
- Other	\$28,431,344	1,115,762	\$25

Table 3.7.5-1. Number of employees, and annual percent change by industry in Los Angeles County, California. Data from County Business Patterns, U.S. dept. of Commerce (1982,1990). Excludes government employees, railroad employees and self employed persons. Employment sizeclasses are used in some cases to protect confidential information (size class A = 0 to 19 persons, B = 20 to 99 persons, C = 100 to 249 persons, E = 250 to 499 persons, F = 500 to 999 persons, G = 1,000 to 4,999 persons, H = 5,000 to 9,999 persons).

	1980	1988	1988%	% change
Total Employees	3,184,578	3,628,164	100.00%	1.74%
Maritime Total	20,403	22,143	0.61%	1.07%
Agricultural Services, Forestry and Fishing	10,622	15,223	0.42%	5.41%
- Fishing, Hunting and Trapping	823	275	0.01%	-8.32%
Mining	9,207	6,369	0.18%	-3.85%
Construction	139,204	143,395	3.95%	0.38%
Manufacturing	964,761	891,105	24.56%	-0.95%
- Canned and Cured seafoods	H	848	0.02%	
- Prepared Fresh and Frozen Fish	1,538	1,656	0.05%	0.96%
- Ship and Boat Building and Repair	5,614	2,596	0.07%	-6.72%
- Ship Building and Repair	4,559	1,631	0.04%	-8.03%
- Boat Building and Repair	1,055	965	0.03%	-1.07%
- Other	957,609	886,005	24.42%	-0.93%
Transportation and Public Utilities	189,591	219,815	6.06%	1.99%
Wholesale Trade	244,839	290,919	8.02%	2.35%
- Fish and Seafood	1,161	1,658	0.05%	5.35%
- Other	243,678	289,261	7.97%	2.34%
Retail Trade	532,703	622,070	17.15%	2.10%
- Meat and Fish (seafood) Markets	1,903	2,218	0.06%	2.07%
- Sporting Goods Stores and Bicycle Shops	4,164	4,603	0.13%	1.32%
- Other	538,770	628,891	17.33%	2.09%
Finance, Insurance and Real Estate	253,572	285,731	7.88%	1.59%
Services	815,283	1,124,051	30.98%	4.73%
- Amusement and Recreation	5,200	8,289	0.23%	7.43%
- Other	810,083	1,115,762	30.75%	4.72%

Table 3.8.1-1. Summary of population, housing and income data for San Pedro, California during 1980 and 1990. Figures in table are census data summarized by the City of Los Angeles Planning Commission (1990 and 1991).

	1980		1990		Annual Change
Population	Number	Percent	Number	Percent	
Population Density (persons/acre) 1989 estimate	62,336		69,526		1.2%
Entire Population by Ethnic and Racial Group	9.6		11.4		1.9%
- Total					
- White Non-hispanic	62,004	100.0%	69,526	100.0%	1.2%
- Hispanic	36,994	59.7%	38,228	55.0%	0.3%
- Black	19,082	30.8%	23,972	34.5%	2.6%
- Asian Pacific Islander	2,735	4.4%	3,657	5.3%	3.4%
- Native American	2,659	4.3%	3,207	4.6%	2.1%
- other Non-Hispanic	534	0.9%	348	0.5%	-3.5%
- 114		0.2%			
All Housing Units	25,053		27,904		1.1%
Household Income					
- Mean	\$19,729				
- Wages/Salary	\$14,790				
- Self Employed	\$1,246				
- Interest/Dividends	\$1,287				
- Social Security	\$1,021				
- Public Assistance	\$312				
Employment					
- Civilian Labor Force	27,303	43.8%			
- Professional	6,795	10.9%			
- Management/Administration	5,673	9.1%			
- Technical	1,434	2.3%			
- Sales	5,984	9.6%			
- Clerical	11,719	18.8%			
- Manufacturing/Services	22,129	35.5%			
- Labor	3,990	6.4%			
- Other	4,551	7.3%			
Persons Not in Poverty					
- Under 55 years age	41,204	66.1%			
- 55 to 59 years age	3,179	5.1%			
- 60 to 64 years age	2,743	4.4%			
- Over 64 years age	6,732	10.8%			
Persons in Poverty					
- Under 55 years age	7,231	11.6%			
- 55 to 59 years age	249	0.4%			
- 60 to 64 years age	312	0.5%			
- Over 64 years age	686	1.1%			

Table 3.8.6-1. Ethnicity, median birth year, median age during fishing year and number of crew members on six wetfish boats based in San Pedro during four years

<u>Ethnicity</u>								
<u>Fishing</u> <u>Year</u>		<u>Unknown/</u> <u>Other</u>	<u>Hisp.</u>	<u>Ital.</u>	<u>Asian</u>	<u>Port.</u>	<u>Yugo.</u>	<u>All</u>
1977	Birthyr	1951	1945	1930	1920		1927	1930
	Age	26	32	47	57		50	47
	Number	5	6	53	1	0	33	98
	Proportion	5%	6%	54%	1%	0%	34%	100%
1980	Birthyr	1959	1950	1940	1931		1922	1940
	Age	21	30	40	49		58	40
	Number	3	4	49	2	0	22	80
	Proportion	4%	5%	61%	3%	0%	28%	100%
1985	Birthyr	1960	1952	1939	1931		1935	1940
	Age	25	33	46	54		50	45
	Number	6	6	44	4	0	10	70
	Proportion	9%	9%	63%	6%	0%	14%	100%
1990	Birthyr	1955	1948	1939	1943	1963	1938	1941
	Age	35	42	51	47	27	52	49
	Number	3	15	46	2	1	7	74
	Proportion	4%	20%	62%	3%	1%	9%	100%

In 1985, for example, there were six Hispanic crew members whose median birth year was 1952 and median age was 33 years. Data are for boats affiliated with the Fishermen's Cooperative Association in San Pedro, California, from 1977 to 1990 that had crew members belonging to the Fisherman and Allied Workers Union in San Pedro. Data were obtained from personnel records. Ethnicity of each crew member was determined by surname and checked by someone familiar with the fishery and the crew members. Birth dates were not available for six crew members (<2% of the total sample), who are not included in the table.

Source: Jacobson and Thomson (in press).

Table 3.9.1-1. Socioeconomic profile for Monterey County, 1980-1990. Data for 1980 from Kearny/Centaur (1987). Data for 1990 from Bureau of the Census (1991) and California Employment Development Department, Labor Information Division (personal communication). All dollar values are corrected for inflation and expressed in 1989 dollars. "Asian or Pacific Islander" includes persons who reported themselves as "Chinese," "Filipino," "Japanese," "Asian Indian," "Korean," "Vietnamese," "Other Asian," "Hawaiian," "Samoan," or "Other Pacific Islander." Note that "Hispanic" denotes an ethnic group not a racial group. Racial group statistics are given for the whole population and non-hispanic population. Statistics by racial group for hispanics can be obtained by subtraction (e.g. population of white hispanics in 1990 was 227,008 - 186,166).

	1980		1990		Annual Change
Population	Number	Percent	Number	Percent	
Population Density (persons/square mile)	290,444	100.0%	355,660	100.0%	2.2%
	88	0.03%	107	0.03%	2.2%
Entire Population by Racial Group					
-White	201,278	69.3%	227,008	63.8%	1.3%
-Black	19,169	6.6%	22,849	6.4%	1.9%
-American Indian, Eskomo or Aleut	3,550	1.2%	3,017	0.8%	-1.5%
-Asian or Pacific Islander	20,072	6.9%	27,856	7.8%	3.9%
-Other race	46,761	16.1%	74,930	21.1%	6.0%
Hispanic Origin all Races	75,225	25.9%	119,570	33.6%	5.9%
Non-Hispanic Population by Racial Group					
-White	186,166	52.3%	186,166	52.3%	
-Black	21,506	6.0%	21,506	6.0%	
-American Indian, Eskomo or Aleut			2,124	0.6%	
-Asian or Pacific Islander	25,365	7.1%	25,365	7.1%	
-Other race	929	0.3%	929	0.3%	
Age					
-Under 18	82,295	28.3%	97,951	27.5%	1.9%
-18 to 64	181,364	62.4%	223,012	62.7%	2.3%
-65 and older	26,785	9.2%	34,697	9.8%	3.0%
-Median age	27.8		29.6		0.6%
All Housing Units	103,557	35.7%	121,224	34.1%	1.7%
Avg. Civilian Labor Force	124,740	42.9%	160,600	45.2%	2.9%
Civilian Unemployment Rate	9.1%		8.8%		-0.3%
Per Capita Income	\$16,427		\$17,622		0.8%

Table 3.9.3-1. Annual payroll (in thousands of 1989 dollars) for Monterey County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1977, 1982, 1987, 1988, 1989, 1990). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1975	1980	1985	1986	1987	1988
Total Annual Payroll	\$899,435	\$1,134,817	\$1,382,766	\$1,413,925	\$1,495,253	\$1,547,982
Maritime Total	\$4,594	\$3,957	\$4,855	\$7,089	\$6,249	\$5,243
Agricultural Services, Forestry and Fishing	\$20,074	\$23,931	\$45,303	\$42,421	\$50,182	\$47,784
- Fishing, Hunting and Trapping	\$1,834	D	D	D		
- Other	\$18,240	\$23,931	\$45,303	\$42,421	\$50,182	\$47,784
Mining	\$17,780	\$18,032	\$5,905	\$3,623	\$2,292	\$1,667
Construction	\$63,559	\$87,931	\$92,076	\$99,693	\$103,834	\$114,563
Manufacturing	\$174,820	\$190,153	\$206,577	\$217,081	\$203,391	\$234,535
- Canned and Cured Seafood	D	D	D	\$1,235	D	D
- Prepared Fresh and Frozen Fish				\$215,846		
- Other						
Transportation and Public Utilities	\$63,040	\$87,773	\$123,012	\$121,875	\$127,389	\$128,103
Wholesale Trade	\$94,789	\$102,234	\$106,516	\$110,679	\$121,406	\$141,692
Retail Trade	\$206,139	\$251,514	\$295,878	\$296,533	\$305,216	\$299,159
- Meat and Fish (seafood) Markets		\$761		\$482	\$708	
- Sporting Goods Stores and Bicycle Shops	\$988	\$1,070	\$3,151	\$3,420	\$3,808	\$2,648
- Other	\$205,151	\$251,204	\$292,727	\$293,594	\$302,116	\$296,511
Finance, Insurance and Real Estate	\$53,697	\$86,939	\$103,638	\$110,686	\$113,343	\$104,905
Services	\$195,430	\$278,598	\$380,159	\$387,664	\$461,440	\$458,778
- Amusement and Recreation	\$1,772	\$2,127	\$1,704	\$1,952	\$1,732	\$2,594
- Other	\$193,658	\$276,472	\$378,455	\$385,713	\$459,708	\$456,183

Table 3.9.3-2. Real Annual Payroll (\$1000, 1989 dollars), 1988 Payroll Composition by industry for 1980 and 1988, Monterey County, California . Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1990). Excludes government employees, railroad employees and self-employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1980	1988	1988%	% change
Population				
Martime Summary	\$3,957	\$5,243	0.3%	4.1%
Total Annual Payroll	\$1,134,817	\$1,547,982	100.0%	4.6%
Agricultural Services, Forestry and Fishing	\$23,931	\$47,784	3.1%	12.5%
- Fishing, Hunting and Trapping	D		0.0%	
- Other	\$23,931	\$47,784	3.1%	12.5%
Mining	\$18,032	\$1,667	0.1%	-11.3%
Construction	\$87,931	\$114,563	7.4%	3.8%
Manufacturing	\$190,153	\$234,535	15.2%	2.9%
- Canned and Cured Seafood		D	0.0%	
- Prepared Fresh and Frozen Fish	D		0.0%	
- Other			0.0%	
Transportation and Public Utilities	\$87,773	\$128,103	8.3%	5.7%
Wholesale Trade	\$102,234	\$141,692	9.2%	4.8%
Retail Trade	\$251,514	\$299,159	19.3%	2.4%
- Meat and Fish (seafood) Markets	\$761		0.0%	
- Sporting Goods Stores and Bicycle Shops	\$1,070	\$2,648	0.2%	18.4%
- Other	\$251,204	\$296,511	19.2%	2.3%
Finance, Insurance and Real Estate	\$86,939	\$104,905	6.8%	2.6%
Services	\$278,598	\$458,778	29.6%	8.1%
- Amusement and Recreation	\$2,127	\$2,594	0.2%	2.7%
- Other	\$276,472	\$456,183	29.5%	8.1%

Table 3.9.3-4. Number of employees, and annual change by industry for Monterey County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1990). Excludes government employees, railroad employees, and self employed persons. Employment size classes are used in some cases to protect confidential information (size class A = 0 to 19 persons, B = 20 to 99 persons, C = 100 to 249 persons, E = 250 to 499 persons, F = 500 to 999 persons, G = 1,000 to 4,999 persons, H = 5,000 to 9,999 persons).

	1980	1988	1988%	% change
Martime Summary	383	434	0.5%	1.7%
Total Employment	64,801	79,157	100.0%	2.8%
Agricultural Services, Forestry and Fishing	1,224	2,202	2.8%	10.0%
- Fishing, Hunting and Trapping	C		0.0%	
- Other			0.0%	
Mining	521	37	0.0%	-11.6%
Construction	3,402	4,461	5.6%	3.9%
Manufacturing	8,947	8,562	10.8%	-0.5%
- Canned and Cured Seafood		E	0.0%	
- Prepared Fresh and Frozen Fish	C		0.0%	
- Other			0.0%	
Transportation and Public Utilities	3,729	4,666	5.9%	3.1%
Wholesale Trade	4,246	5,051	6.4%	2.4%
Retail Trade	19,321	23,269	29.4%	2.6%
- Meat and Fish (seafood) Markets	58		0.0%	-12.5%
- Sporting Goods Stores and Bicycle Shops	114	202	0.3%	9.6%
- Other	19,149	23,067	29.1%	2.6%
Finance, Insurance and Real Estate	4,689	4,526	5.7%	-0.4%
Services	18,055	25,440	32.1%	5.1%
- Amusement and Recreation	211	232	0.3%	1.2%
- Other	17,844	25,208	31.8%	5.2%

Table 3.9.4-1. Annual payroll, number of employees and payroll per employee (\$1000, 1989 dollars) by industry for 1980 and 1988, Monterey County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1990). Excludes government employees, railroad employees and self-employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1988 emp	1988 rpay	rpay/emp
Population			
Maritime Summary	434	\$5,243	\$12
Total Annual Payroll	79,157	\$1,547,982	\$20
Agricultural Services, Forestry and Fishing	2,202	\$47,784	\$22
- Fishing, Hunting and Trapping			
- Other		\$47,784	
Mining	37	\$1,667	\$45
Construction	4,461	\$114,563	\$26
Manufacturing	8,562	\$234,535	\$27
- Canned and Cured Seafood		D	
- Prepared Fresh and Frozen Fish			
- Other			
Transportation and Public Utilities	4,666	\$128,103	\$27
Wholesale Trade	5,051	\$141,692	\$28
Retail Trade	23,269	\$299,159	\$13
- Meat and Fish (seafood) Markets			
- Sporting Goods Stores and Bicycle Shops	202	\$2,648	\$13
- Other	23,067	\$296,511	\$13
Finance, Insurance and Real Estate	4,526	\$104,905	\$23
Services	25,440	\$458,778	\$18
- Amusement and Recreation	232	\$2,594	\$11
- Other	25,208	\$456,183	\$18

Table 3.9.8-1. Residence of fishers belonging to AFL-CIO Fisherman's Union in the San Pedro area, Los Angeles County, California.

Number	County	Zip Code	Specific area
184	100.00%		Los Angeles County Total
136	73.91%	97031	Terminal Is. Fort MacArthur
14	7.61%	90011	Washington Station, Los Angeles
12	6.52%	90732	Fidelity Federal Bldg. 29000 Western Ave.
4	2.17%	90745	Carson
3	1.63%	90744	Wilmington
3	1.63%	90717	Lomita
2	1.09%	90733	San Pedro
2	1.09%	90274	Palos Verdes Peninsula
2	1.09%	90280	South Gate
1	0.54%	91401	Van Nuys
1	0.54%	90501	Torrance
1	0.54%	90007	Adams Blvd., Los Angeles
1	0.54%	90810	Cabrillo, Long Beach
1	0.54%	95456	Northern Cal
1	0.54%	unknown	
San Diego County Area			
4		92139	San Diego
Monterey County Area			
128	100.00%		Monterey County Total
102	79.69%	93940	Monterey
15	11.72%	93955	Seaside
5	3.91%	93950	Pacific Grove
4	3.13%	93933	Marina
1	0.78%	93930	King City
1	0.78%	93923	Carmel

Table 3.10.1-1. Socioeconomic profile for Ventura County, 1980-1990. Data for 1980 from Centaur (1984). Data for 1990 from Bureau of the Census (1991) and California Employment Development Department, Labor Information Division (personal communication). All dollar values are corrected for inflation and expressed in 1989 dollars. "Asian or Pacific Islander" includes persons who reported themselves as "Chinese," "Filipino," "Japanese," "Asian Indian," "Korean," "Vietnamese," "Other Asian," "Hawaiian," "Samoan," or "Other Pacific Islander." Note that "Hispanic" denotes an ethnic group not a racial group. Racial group statistics are given for the whole population and non-Hispanic population. Statistics by racial group for hispanics can be obtained by subtraction (e.g. population of white hispanics in 1990 was 529,166 - 440,555).

	1980		1990		Annual Change
Population	Number	Percent	Number	Percent	
Population Density (persons/square mile)	529,174	100.0%	669,016	100.0%	2.6%
	284	0.1%	362	0.1%	2.8%
Entire Population by Racial Group					
-White	425,688	80.4%	529,166	79.1%	2.4%
-Black	11,199	2.1%	15,629	2.3%	4.0%
-American Indian, Eskomo or Aleut			4,909	0.7%	
-Asian or Pacific Islander			34,579	5.2%	
-Other race	92,287	17.4%	84,733	12.7%	-0.8%
Hispanic Origin all Races	113,192	21.4%	176,952	26.4%	5.6%
Non-Hispanic Population by Racial Group					
-White			440,555	65.9%	
-Black			14,559	2.2%	
-American Indian, Eskomo or Aleut			3,430	0.5%	
-Asian or Pacific Islander			32,665	4.9%	
-Other race			855	0.1%	
Age					
-Under 18	165,006	31.2%	182,986	27.4%	1.1%
-18 to 64	320,367	60.5%	423,025	63.2%	3.2%
-65 and older	43,801	8.3%	63,005	9.4%	4.4%
-Median age	28.6		31.7		1.1%
All Housing Units	183,384	34.7%	228,478	34.2%	2.5%
Avg. Civilian Labor Force	232,800	44.0%	374,500	56.0%	6.1%
Civilian Unemployment Rate	6.7%		5.5%		-1.8%
Per Capita Income	\$16,861		\$20,156		2.2%

Table 3.10.3-1. Annual payroll (in thousands of 1989 dollars) for Ventura County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1977, 1982, 1987, 1988, 1989, 1990). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies.

	1975	1980	1985	1986	1987	1988
Total Annual Payroll	\$1,463,093	\$2,209,559	\$3,277,463	\$3,507,139	\$3,781,738	\$4,016,358
Maritime Total	\$6,474	\$6,084	\$6,419	\$5,241	\$6,566	\$9,859
Agricultural Services, Forestry and Fishing	\$25,153	\$40,162	\$35,476	\$33,661	\$34,679	\$38,213
Mining	\$40,637	\$48,158	\$78,205	\$70,584	\$50,415	\$43,138
Construction	\$113,198	\$215,941	\$22,149	\$260,955	\$322,511	\$358,772
Manufacturing	\$388,096	\$557,113	\$929,407	\$935,364	\$956,567	\$969,192
- Prepared Fresh and Frozen Fish		D	D		D	\$1,794
- Ship and Boat Building and Repair						\$981
- Ship Building and Repair						\$981
- Boat Building and Repair						\$966,417
- Other						
Transportation and Public Utilities	\$90,633	\$137,041	\$270,494	\$272,357	\$283,249	\$295,952
Wholesale Trade	\$101,228	\$144,153	\$197,781	\$211,714	\$261,249	\$266,781
Retail Trade	\$292,810	\$241,898	\$491,715	\$551,834	\$554,276	\$571,896
- Meat and Fish (seafood) Markets	\$1,401	D	\$1,035	\$1,004	\$1,228	\$1,312
- Sporting Goods Stores and Bicycle Shops	\$1,836	\$2,556	\$3,819	\$3,758	\$3,552	\$4,091
- Other	\$289,573	\$239,343	\$486,862	\$547,072	\$549,497	\$566,493
Finance, Insurance and Real Estate	\$110,957	\$165,181	\$218,027	\$184,458	\$315,803	\$318,647
Services	\$289,022	\$493,870	\$791,388	\$861,730	\$990,306	\$1,108,430
- Amusement and Recreation	\$3,237	\$3,528	\$1,565	\$479	\$1,787	\$1,681
- Other	\$285,786	\$490,342	\$789,823	\$861,251	\$988,519	\$1,106,749

Table 3.10.5-1. Number of employees, and annual percent changes by industry for Ventura County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1990). Excludes government employees, railroad employees, and self employed persons. Employment size classes are used in some cases to protect confidential information (size class A = 0 to 19 persons, B = 20 to 99 persons, C = 100 to 249 persons, E = 250 to 499 persons, F = 500 to 999 persons, G = 1,000 to 4,999 persons, H = 5,000 to 9,999 persons).

	1980	1988	1988%	% change
Total Employees	117,238	186,813	100.00%	7.42%
Maritime Total	689	959	0.51%	4.90%
Agricultural Services, Forestry and Fishing	2,648	2,843	1.52%	0.92%
Mining	136	1,571	0.84%	131.89%
Construction	8,406	15,480	8.29%	10.52%
Manufacturing	23,681	33,248	17.80%	5.05%
- Prepared Fresh and Frozen Fish	B	214	0.11%	
- Ship and Boat Building and Repair		51	0.03%	
- Ship Building and Repair				
- Boat Building and Repair		51	0.03%	
- Other		32,983	17.66%	
Transportation and Public Utilities	5,906	10,748	5.75%	10.25%
Wholesale Trade	6,603	9,906	5.30%	6.25%
Retail Trade	31,012	46,346	24.81%	6.18%
- Meat and Fish (seafood) Markets	C	110	0.06%	
- Sporting Goods Stores and Bicycle Shops	248	378	0.20%	6.55%
- Other	30,764	45,858	24.55%	6.13%
Finance, Insurance and Real Estate	7,818	12,960	6.94%	8.22%
Services	28,306	52,681	28.20%	10.76%
- Amusement and Recreation	441	206	0.11%	-6.66%
- Other	27,865	52,475	28.09%	11.04%

REFERENCES

- Ahlstrom, E. H. 1960. Synopsis on the biology of the Pacific sardine (Sardinops caerulea). Proc. World Sci. Meet. Biol. Sardines and Related Species, FAO, Rome, 2: 415-451
- Ainley, D. G., and R. J. Boekelheide [ed.] 1990. Seabirds of the Farallon Islands: Ecology, dynamics, and structure of an upwelling-system community. Stanford University Press, Stanford. 488 p.
- Ainley, D. G., H. R. Huber, and K. M. Bailey. 1982. Population fluctuations of California sea lions and the Pacific whiting fishery off central California. Fish. Bull. 80: 253-258.
- Ainley, D. G., and G. L. Hunt. 1991. Status and conservation of seabirds in California. ICBP Tech. Publ. 11: 103-114.
- Ainley, D. G., and T. J. Lewis. 1974. The history of Farallon Island marine bird populations, 1843-1972. Condor 76: 432:446.
- Allen, M. J., R. J. Wolotira, Jr., T. M. Sample, S. F. Noel, and C. R. Iten. 1990. West coast of North America coastal and oceanic zones strategic assessment: Data Atlas. N.O.A.A. Seattle, WA. Invertebrate and fish 145:
- Anderson, D. W., F. Gress, and K. F. Mais. 1982. Brown pelicans: influence of food supply on reproduction. Oikos 39: 23-31.
- Anderson, D. W., F. Gress, K. F. Mais, and P. R. Kelly. 1980. Brown pelicans as anchovy stock indicators and their relationships to commercial fishing. CalCOFI Rep. 21: 54-61.
- Antonelis, G. A. Jr., and C. H. Fiscus. 1980. The Pinnipeds of the California current. CalCOFI Rep. 21: 68-78.
- Antonelis, G. A., Jr., C. H. Fiscus, and R. L. DeLong. 1984. Spring and summer prey of California sea lions, Zalophus californianus, at San Miguel Island, California, 1978-79. Fish. Bull. 82: 67-76.
- Antonelis, G. A. Jr., M. S. Lowry, D. P. DeMaster, and C. H. Fiscus. 1987. Assessing northern elephant seal feeding habits by stomach lavage. Marine Mammal Science 3: 308-322.

- Antonelis, G. A. Jr., and M. A. Perez. 1984. Estimated annual food consumption by northern fur seals in the California current. CalCOFI Rep. 25: 135-145.
- Bailey, K. M., R. C. Francis, and P. R. Stevens. 1982. The life history and fishery of Pacific whiting, Merluccius productus. CalCOFI Rep. 23: 81-98.
- Baltz, D. M., and G. V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. Auk 94: 526-543.
- Barlow, J. 1988. Harbor Porpoise, Phocoena phocoena, Abundance estimation for California, Oregon, and Washington: I. Ship Surveys. Fish. Bull. 86(3): 417-432.
- Barnes, J. T., L. D. Jacobson, A. D. MacCall, and P. Wolf. 1992. Recent population trends and abundance estimates of the Pacific sardine (Sardinops sagax). CalCOFI Rep. (in press).
- Baumgartner, T., A. Soutar, and V. Ferriera-Bartrina. 1992. Reconstruction of the history of pacific sardine and northern anchovy populations over the past two millenia from sediments of the Santa Barbara Basin, California. CalCOFI Rep. 33: (in press).
- Beach, R. J., A. C. Geiger, S. J. Jeffries, and S. D. Treacy. 1981. Marine Mammal - Fisheries interactions on the Columbia River and adjacent waters, 1981. NWAFC Processed Rept. 82-04. 186 p.
- Beddington, J. R., and J. G. Cooke. 1983. The potential yield of fish stocks. FAO Fish. Tech. Pap. 242.
- Beddington, J. R., and R. M. May. 1977. Harvesting natural populations in a randomly fluctuating environment. Science, July 29: 463-465.
- Bonnot, P. 1928. Report on the seals and sea lions of California. Calif. Dept. Fish and Game, Fish Bull. 14: 1-62.
- Boveng, P. 1988. Status of the pacific harbor seal population on the U. S. west coast. NMFS, SWFSC Admin. Rep. LJ-88-06. 43 p.
- Bramel, B., and M. Kronman. 1991. Adapting lampara nets to small gill net vessels. A report to California's Office of Environmental Protection. 58 p.

- Briggs, K. T., and E. W. Chu. 1987. Trophic relationships and food requirements of California seabirds: updating models of trophic impact, p. 279-304 In: J. P. Croxall [ed.] Seabirds: feeding ecology and role in marine ecosystems. Cambridge Univer. Press.
- Briggs, K. T., W. B. Tyler, D. B. Lewis, and D. R. Carlson. 1987. Bird communities at sea off California: 1975 to 1983. *Studies Avian Biology* 11: 1-74.
- Brownell, R. L. Jr. 1964. Observations of odontocetes in central Californian waters. *Norsk Hvalfangst-Tidende* 3: 60-66.
- Bureau of the Census. 1991. 1990 Census of population and housing. Summary population and housing characteristics. California. U.S. Dept. of Commerce. Economics and Statistics Administration Bureau of the Census. 1990 CPH-1-6.
- Butler, J. L. 1987. Comparisons of the larval and juvenile growth and mortality rates of Pacific sardine and northern anchovy and implications for species interactions. PhD. thesis, Univ. Calif. San Diego. 242 p.
- California Department of Fish and Game. 1970. The California marine fish catch for 1968 and historical review 1916-1968. *Fish Bull.* 149.
- California Department of Fish and Game. 1986. Review of some California fisheries for 1985. *CalCOFI Rep.* 27: 7-15.
- California Department of Fish and Game. 1991a. Review of some California fisheries for 1990. *CalCOFI Rep.* 32: 7-20.
- California Department of Fish and Game. 1991b. Marine resources protection act of 1990. Annual report 1990-91. 14 p.
- California Department of Fish and Game Code. 1991. Gould publications, Altamonte Springs, FL. 618 p.
- California Legislature Senate Committee on Governmental Organization. 1986. Interim hearing on problems relating to the commercial fishing industry and economic development in the Los Angeles harbor area. Los Angeles Harbor Dept. 102 p.

- Cannon, R. 1967. How to fish the Pacific Coast. 3rd edition. Lane Books, Menlo Park, CA. 160 p.
- Centaur Associates. 1984. Cumulative socioeconomic impacts of oil and gas development in the Santa Barbara channel region: a case study. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region.
- Chavez, H., S. Silva and J. Sunada. 1977. The fishery for northern anchovy, Engraulis mordax, off California and Baja California in 1975. CalCOFI Rep. 19: 147-165.
- Clark, F. N. 1939. Can the supply of sardines be maintained in California waters? Calif. Fish and Game 25: 172-176.
- Clark, F. N., and J. F. Janssen. Jr. 1945. Movements and abundance of the sardine as measured by tag returns. Calif. Div. Fish Game Fish. Bull. 61: 7-42.
- Clark, F. N., and J. C. Marr. 1955. Population dynamics of the Pacific sardine. CalCOFI Prog. Rep. 1 July 1953-31 March 1955: 11-48.
- Clemmens, W. A., and G. V. Wilby. 1961. Fishes of the Pacific coast of Canada. Fish. Res. Board Can., Bull. 68. 443 p.
- Collette, B. B., and C. E. Nauen. 1983. Scombrids of the world. FAO Fish. Synop. 125. 137 p.
- Conrad, J. M. 1991. A bioeconomic analysis of the northern anchovy. NMFS, Southwest Fisheries Science Center Admin. Rep. LJ-91-26: 34 p.
- Cooperrider, C. L. 1987. Commercial passenger fishing vessel landings of widow rockfish Sebastes entomelas in central California. p. 49-52. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.
- Crawford, R. J. M., and P. A. Shelton. 1978. Pelagic fish and seabird interrelationships off the coasts of South West and South Africa. Biol. Conserv. 14: 85-109.
- Cushing, D. H. 1971. The dependence of recruitment of parent stock on different groups of fishes. J. Cons. Int. Explor. Mer. 33: 340-362.
- Demory, R. 1987. The widow rockfish fishery in Oregon, 1963-80. p. 9. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.

- Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm.
1983. Cetaceans of central and northern California,
1980-1983: status, abundance, and distribution. Center
for Marine Studies, University of Calif., Santa Cruz.
Prepared for Pacific OCS Region, Minerals Management
Service, U.S. Department of Interior, Contract #14-12-
0001-29090. 284 p.
- Dorsey E. M., S. J. Stern, A. R. Hoelzel, and J. Jacobsen.
1990. Minke whales (Balaenoptera acutorostrata) from
the west coast of North America: Individual recognition
and small-scale site fidelity. Rep. Int. Whal. Commn.
Special issue 12: 357-368.
- Environmental Perspectives. 1989. Final environmental
impact report (including draft EIR). Fort Macarthur
Educational Complex at the Fort Macarthur upper
reservation. Master plan of facilities. Los Angeles
Unified School District.
- Fitch, J. E. 1951. Age composition of Southern California
catch of Pacific mackerel 1939-1940 through 1950-1951.
Calif. Dep. Fish and Game, Fish. Bull. 83: 77 p.
- Fitch, J. E. 1969. Offshore fishes of California. 4th
revision. Calif. Dep. Fish and Game, Sacramento, CA.
79 p.
- Fitch, J. E., and R. L. Brownell, Jr. 1968. Fish otoliths
in cetacean stomachs and their importance in
interpreting feeding habits. J. Fish. Res. Bd. Canada,
25: 2561-2574.
- Fitch, J. E., and R. J. Lavenberg. 1971. Marine food and
game fishes of California. Univ. Calif. Press,
Berkley, CA. 179 p.
- Fowler, C. W. (in press). Northern fur seals of the
Pribilof Islands. In: The northern fur seal. Species
of the fauna of the USSR and the contiguous countries.
USSR Academy of Sciences, Nauka, Moscow.
- Frey, H. W. [ed.] 1971. California's living marine
resources and their utilization. Calif. Dept. Fish and
Game 148 p.
- Fritzsche, R. A. 1978. Development of fishes in the Mid-
Atlantic Bight, Vol. 5. Chaetodontidae through
Ophidiidae. U.S. Fish Wildl. Serv., Washington, D.C.
FWS/OBS-78/12. 340 p.

- Furness, R. W., and D. G. Ainley. 1984. Threats to seabird populations presented by commercial fisheries. ICBP Tech. Publ. 2: 701-708.
- Gearin, P. J., and M. A. Johnson. 1991. Harbor porpoise food habits in Washington state. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 26.
- Glantz, M. H., and J. D. Thompson [ed.] 1981. Resource mangement and environmental uncertainty: Lessons from coastal upwelling fisheries. Wiley, New York. 491 p.
- Gulland, J. A. 1970. Preface. In: J. Gulland [ed.] The fish resources of the oceans. FAO Fish. Tech. Paper 97: 1-4.
- Hacker, E. S. 1986. Stomach content analysis of short-finned pilot whales (Globicephala macrorhynchus) and northern elephant seals (Mirounga angustirostris) from the southern California Bight. NMFS, SWFSC Admin. Rep. LJ-86-08C. 34 p.
- Hansen, L. J. 1990. California coastal bottlenose dolphins. p. 403-420. In: S. Leatherwood and R. Reeves, [ed.] The bottlenose dolphin. Academic Press, San Diego, CA.
- Hart, J. L. 1973. Pacific fishes of Canada. Fish. Res. Board Can., Bull. 180. 740 p.
- Hedgecock, D., E. S. Hutchinson, G. Li, F. L. Sly, and K. Nelson. 1989. Genetic and morphometric variation in the Pacific sardine, Sardinops sagax caerulea: comparisons and contrasts with historical data and with variability in the northern anchovy, Engraulis mordax. Fish. Bull. 87: 653-671.
- Heyning, J. E., and W. F. Perrin. 1991. Re-examination of two forms of common dolphins (genus Delphinus) from the eastern North Pacific; evidence for two species. NMFS Admin. Rep. LJ-91-28, 37 p.
- Hitz, C. R. 1970. Operation of the Soviet trawl fleet off the Washington and Oregon coasts during 1966 and 1967. p. 53-75. In: Pacific hake. U.S. Department of the Interior, FWS, BCF, circular 332.
- Huber, H. R., S. Jeffries, R. Brown, and R. DeLong. 1992. Abundance of harbor seals in Washington and Oregon. Annual Report, MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA. Silver Springs, MD.

- Hunt, G. L., and J. Butler. 1980. Reproductive ecology of Western Gulls and Xantus' Murrelets with respect to food resources in the Southern California Bight. CalCOFI Rep. 21: 62-67.
- Huppert, D. D. 1981. Economic analysis for northern anchovy management. p.41-80. In: L. G. Anderson [ed.] Economic analysis for fisheries management plans. Ann Arbor Science Publishers, Ann Arbor, MI.
- ICF Technology, San Diego, and Knecht, Cicin-Sain and Associates, Santa Barbara. 1988. Toward a more abundant ocean: improving fisheries management in California. Development of alternative management approaches. Prepared for National Coalition for Marine Conservation-Pacific Region. 2: 51 p.
- Idyll, C.P. 1973. The anchovy crisis. Sci. American 228: 145-149.
- Jacobson, L. D., and N. C. Lo. 1991. Spawning biomass of the northern anchovy in 1991. NMFS, SWFSC Admin. Rep. LJ-91-19: 53 p.
- Jacobson, L. D., and C. J. Thomson. 1989. Evaluation of options for managing northern anchovy--a simulation model. NMFS, SWFC Admin. Rep. LJ-89-26: 98 p.
- Jacobson, L. D., and C. J. Thomson. In press. Opportunity cost and the decision to fish for northern anchovy. Accepted by North American Journal of Fisheries Management.
- Jones, R. E. 1981. Food habits of smaller marine mammals from northern California. Proceedings of the Ca. Acad. of Sci. 42(16): 409-433.
- Kajimura, H. 1984. Opportunistic feeding of the northern fur seal, Callorhinus ursinus, in the Eastern North Pacific Ocean and Eastern Bering Sea. NOAA Tech. Rep. NMFS SSRF-779. 49 p.
- Kajimura, H., C. H. Fiscus, and R. K. Stroud. 1981. Food of Pacific white-sided dolphin Lagenorhynchus obliquidens, Dall's porpoise Phocoenoides dalli and northern fur seal, Callorhinus ursinus, off California and Washington with appendices on size and food of Dall's porpoise from Alaska Waters. NOAA Tech. Memo. NMFS/F/NWC2. 30 p.
- Kato, S., and J. E. Hardwick. 1975. The California squid fishery. FAO Fish. Rep. (170) Suppl. 107-147.

- Kearney/Centaur Division. 1987a. Baseline socioeconomic profiles of coastal counties in the central California planning area. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS 87-0053.
- Kearney/Centaur Division. 1987b. Baseline socioeconomic profiles of coastal counties in the southern California planning area. U. S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS 87-0054.
- Kieckhefer, T. R. 1991. Feeding ecology of humpback whales in and around the Gulf of the Farallons, California. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 39.
- Klingbeil, R. A. 1983. Pacific mackerel: A resurgent resource and fishery of the California current. CalCOFI Rep. 24: 35-45.
- Leatherwood, S. 1975. Some observations of feeding behavior of bottle-nosed dolphins (Tursiops truncatus) in the northern Gulf of Mexico and (Tursiops cf T. gilli) off southern California, Baja California, and Nayarit, Mexico. Mar. Fish. Rev. 37(9): 10-16.
- Leatherwood, S., R. R. Reeves, W. F. Perrin, W. E. Evans, and L. Hobbs. 1982. Whales, dolphins, and porpoises of the eastern north Pacific and adjacent Arctic waters: A guide to their identification. NOAA Tech. Rep. NMFS Circ. 444, 245 p.
- Leatherwood, S., and W. A. Walker. 1982. Population biology and ecology of the Pacific white-sided dolphin Lagenorhynchus obliquidens in the Northeastern Pacific. Part 1: Distribution, seasonal movements and abundance with a bibliography and summary of specimen material. NMFS Admin. Rep. LJ-82-18C, 45 p.
- Le Boeuf, B. J., and M. L. Bonnell. 1980. Pinnipeds of the California islands: Abundance and distribution. p. 475-493. In: D. M. Power [ed.] The California islands: Proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History.
- Lluch-Belda, D., R. J. M. Crawford, T. Kawasaki, A. D. MacCall, R. H. Parrish, R. A. Schwartzlose, and P. E. Smith. 1989. World-wide fluctuations of sardine and anchovy stocks: The regime problem. S. Afr. J. Mar. Sci. 8: 195-205.

- Lo, N. C., L. D. Jacobson, and J. L. Squire. In press. Indices of relative abundance from fish spotter data. Can. J. Fish. Aquat. Sci.
- Loughlin, T. R., and P. A. Livingston. 1986. Summary of joint research on the diets of northern fur seals and fish in the Bering Sea during 1985. NWAFC Processed Report 86-19. 92 p.
- Loughlin, T. R., and R. L. Merrick. 1989. Comparison of commercial harvest of walleye pollock and northern sea lion abundance in the Bering Sea and Gulf of Alaska, pp 679-700, In: Proceedings of the international symposium on the biology and management of walleye pollock, November 14-16, 1988, Anchorage, AK. Univ. Alaska Sea Grant Rep. AK-SG-89-01.
- Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1990. Survey of northern sea lions (Eumetopias jubatus) in the Gulf of Alaska and the Aleutian Islands during June 1989. U.S. Dep. Comm., NOAA Tech. Memo. NMFS F/NWC-176. 26 p.
- Lowry, M. S., C. W. Oliver, C. Macky, and J. B. Wexler. 1990. Food habits of California sea lions Zalophus californianus at San Clemente Island, California, 1981-86. Fish. Bull. 88: 509-521.
- Lowry, M. S., B. S. Stewart, C. B. Heath, P. K. Yochem, and J. M. Francis. 1991. Seasonal and annual variability in the diet of California sea lions Zalophus californianus at San Nicolas Island, California, 1981-86. Fish. Bull. 89: 331-336.
- MacCall, A. D. 1979. Population estimates for the waning years of the Pacific sardine fishery. CalCOFI Rep. 20: 72-82.
- MacCall, A. D. 1984. Seabird-fishery trophic interactions in eastern boundary currents: California and Peru, p. 136-149. In: D. N. Nettleship, G. A. Sanger, and P. F. Springer [eds.]. Marine birds: their feeding ecology and commercial Fisheries relationships. Minister Supply Serv., Ottawa.
- MacCall, A. D. 1990. Dynamic geography of marine fish populations. University of Washington Press. 153 p.

- MacCall, A. D., H. W. Frey, D. D. Huppert, E. H. Knaggs, J. A. McMillan, and G. D. Stauffer. 1980. Biology and economics of the fishery for jack mackerel in the northeastern Pacific. NOAA Tech. Mem. NMFS NOAA-TM-NMFS-SWFC-4: 79 p.
- MacCall, A. D., R. A. Klingbeil, and R. D. Methot. 1985. Recent increased abundance and potential productivity of Pacific mackerel (Scomber japonicus). Calif. Coop. Oceanic Fish. Invest. Rep. 26: 119-129.
- MacCall, A. D., and M. H. Prager. 1988. Historical changes in abundance of six fish species off southern California, based on CalCOFI egg and larva samples. CalCOFI Rep. 29: 91-101.
- MacCall, A. D., and G. D. Stauffer. 1983. Biology and fishery potential of jack mackerel (Trachurus symmetricus) CalCOFI Rep. 24: 46-56.
- MacCall, A. D., G. D. Stauffer and J. P. Troadec. 1976. Southern California recreational and commercial marine fisheries. Mar. Fish. Rev. 38(1): 1-32.
- Malme, C. I., P. W. Smith, Jr., and P. R. Miles. 1986. Characterization of geophysical acoustic survey sounds. U. S. Dept. of Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS-86-0032. Los Angeles, California. 91 p.
- Mason, J. E. 1991. Variations in the catch of jack mackerel in the southern California purse seine fishery. CalCOFI Rep. 32: 143-151.
- MBC Applied Environmental Sciences. 1987. Ecology of important fisheries species offshore California. OCS-Study, MMS 86-0093. 252 p.
- Mead, G. W. 1953. The food habits of the northern fur seal in Japanese waters, with a study of the fishes found on the feeding grounds. Ph.D. Thesis, Stanford University, California, 138 p.
- Merrick, R. L., L. M. Ferm, R. D. Everitt, R. R. Ream, and L. A. Lessart. 1991. Aerial and ship-based surveys of northern sea lions (Eumetopias jubatus) in the Gulf of Alaska and Aleutian Islands during June and July 1990. U.S. Dept. Comm., NOAA Tech. Memo. NMFS F/NWC-196. 34 p.

- Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, Eumetopias jubatus, in Alaska, 1956-86. Fish. Bull. 85: 351-365.
- Methot, R. D. 1989. Synthetic estimates of historical abundance and mortality for northern anchovy. p. 66-82. In: E. Edwards and B. Megrey [ed.] Mathematical analysis of fish stock dynamics: reviews, evaluations and current applications. Am. Fish. Soc. Symp. Ser. No. 6. American Fisheries Society, Bethesda, MD.
- Murphy, G. I. 1966. Population biology of the Pacific sardine (Sardinops caerulea). Proc. Cal. Acad. Sci. 34: 1-84.
- Myers, R. A., W. Blanchard, and K. R. Thompson. 1990. Summary of north atlantic fish recruitment 1942-1987. Can. Tech. Rep. Fish Aquat. Sci. No. 1743: 108 p.
- National Marine Fisheries Service. 1984. Marine recreational fishery statistics survey, Pacific coast, 1981-1982. Current Fishery Statistics 8323.
- National Marine Fisheries Service. 1985a. Marine recreational fishery statistics survey, Pacific coast, 1983-1984. Current Fishery Statistics 8325.
- National Marine Fisheries Service. 1985b. Marine recreational fishery statistics survey, Pacific coast, 1985. Current Fishery Statistics 8328.
- National Marine Fisheries Service. 1987. Marine recreational fishery statistics survey, Pacific coast, 1986. Current Fishery Statistics 8393.
- Nelson, M. O. 1970. Pacific hake fishery in Washington and Oregon coastal waters. p. 43-52. In: Pacific hake. U.S. Department of the Interior, FWS, BCF, circular 332.
- Norris, K. S., and J. H. Prescott. 1961. Observations on Pacific cetaceans of California and Mexican waters. Univ. Calif. Publ. Zool. 63: 291-401.
- Orbach, M. K., and J. Beckwith. 1980. A report on the adaptation of Indochinese refugees to the fishing industry and community of Monterey Bay. Center for Coastal Marine Studies, UC Santa Cruz. 38 p.

- Osuna, O. A. P., and A. A. Avalos. 1976. Estadísticas básicas de la explotación de sardina en el noroeste de México. Instituto Nacional de Pesca. INP/SI:i79.
- Parrish, R. H., A. Bakun, D. M. Husby, and C. S. Nelson. 1982. Comparative climatology of selected environmental processes in relation to eastern boundary current pelagic fish reproduction. FAO, Fish. Rep. 291: 731-777.
- Parrish, R. H., and A. D. MacCall. 1978. Climate variation and exploitation in the Pacific mackerel fishery. Calif. Dep. Fish Game, Fish. Bull. 167. 110p.
- Parrish, R. H., D. L. Mallicoate, and K. F. Mais. 1985. Regional variations in the growth and age composition of northern anchovy, Engraulis mordax. Fish. Bull. 83: 483-496.
- Parrish, R. H., C. S. Nelson and A. Bakun. 1981. Transport mechanisms and reproductive success of fishes in the California current. Biol. Oceanogr. 1(2): 175-203.
- Parrish, R. H., R. Serra, and W. S. Grant. 1989. The monotypic sardines, Sardina and Sardinops: their taxonomy, distribution, stock structure and zoogeography. Can. J. Fish. Aquat. Sci. 46: 2019-2036.
- Pearcy, W., J. Fisher, R. Brodeur, and S. Johnson. 1985. Effects of the 1983 El Niño on coastal nekton off Oregon and Washington. p. 188-204. In: El Niño North: Niño effects in the eastern subarctic Pacific Ocean. W.S. Wooster and D.L. Fluharty [ed.] Washington Sea Grant Program. Univ. of Washington, Seattle.
- Pearson, W. H., J. R. Skalski, and C. I. Malme. 1987. Effects of sounds from a geophysical device on fishing success. U. S. Dept. of Interior, Minerals Management Service, Pacific OCS Region, OCS Study MMS-87-0020. Los Angeles, California. 293 p.
- Perrin, W. F. and B. G. Noetzel. 1970. Economic study of the San Pedro wetfish boats. U. S. Fish and Wildlife Service, Fishery Industrial Research 6: 105-138.
- PFMC. 1983. Northern anchovy fishery management plan. Pacific Fishery Management Council, Portland, OR.

- PFMC. 1990. Final amendment 4, supplemental environmental impact statement, regulatory impact review, and initial regulatory flexibility analysis to the Pacific coast groundfish plan. Pacific Fishery Management Council, Portland, OR.
- PFMC. 1990a. Sixth amendment to the northern anchovy fishery management plan. Pacific Fishery Management Council, Portland, OR.
- PFMC. 1990b. Amendment 4 to the Pacific coast groundfish fishery management plan. Pacific Fishery Management Council, Portland, OR.
- PFMC. 1990c. Status of the Pacific coast groundfish fishery through 1990 and recommended acceptable biological catches for 1991. Pacific Fishery Management Council, Portland, OR.
- PFMC, Groundfish Management Team. 1991. Review concerning consistency of the California Proposition 132 with the groundfish fishery management plan. 6 p.
- Phillips, J. B. 1948. Growth of the sardine, Sardinops caerulea, 1941-42 through 1946-47. Calif. Div. Fish Game Fish Bull. 71: 33 p.
- Prager, M. H., and A. D. MacCall. 1988. Revised estimates of historical spawning biomass of the pacific mackerel, *Scomber japonicus*. CalCOFI Rep. 29: 81-90.
- Quirolo, L. F. 1987. Review of data on historical catches of widow rockfish in northern California. p. 7-8. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.
- Radovich, J. 1981. The Collapse of the California Sardine Fishery: What Have We Learned? In Glantz, M. H. and J. D. Thompson (ed.). Resource Management and Environmental Uncertainty. John Wiley & Sons, New York.
- Radovich, J. 1982. The collapse of the California sardine fishery: what have we learned? CalCOFI Rep. 23: 56-78.
- Radtke, H., and W. Jensen. 1987. The west coast seafood industry: its importance to the west coast economy in 1986. Report prepared for Pacific Marine Fisheries Commission. Portland, OR. 53 p.

- Reinstedt, R. A. 1978. Where have all the sardines gone? A pictorial history of Steinbeck's Cannery Row and old Monterey's fisherman's wharf and sardine industry. Ghost Town Publications, Carmel, CA. 167 p.
- Rice, D. W. 1977. Synopsis of biological data on sei whale and Bryde's whale in the eastern north Pacific. Rep. Int. Whal. Commn. (Special Issue 1): 92-97.
- Roedel, P. 1938. Record-size mackerel in Santa Monica Bay. Calif. Fish Game 24: 423.
- Schaffner, F. 1982. Aspects of the reproductive ecology of the elegant tern (Sterna elegans) in San Diego Bay. Unpubl. MS Thesis, San Diego State University.
- Scofield, W. L. 1951. Purse seines and other roundhaul nets in California. Calif. Dept. of Fish and Game Fish Bulletin no. 81.
- Seagars, D. J. 1984. The Guadalupe fur seal: a status review. NMFS, Admin. Rep. SWR-84-6. 29 p.
- Sinclair, E. H. 1988. Feeding habits of northern fur seal (Callorhinus ursinus) in the Eastern Bering Sea. MS Thesis, Oregon State University, Oregon, 94 p.
- Smith, P. E. 1978. Biological effects of ocean variability: time and space scales of biological response. Rapp. P.-v. Reun. Cons. int. Explor. Mer. 173: 117-127.
- Soutar, A., and J. D. Isaacs, 1969. History of fish populations inferred from fish scales in anaerobic sediments off California. CalCOFI Rep. 13: 63-70.
- Soutar, A., and J. D. Isaacs. 1974. Abundance of pelagic fish during the 19th and 20th centuries as recorded in anaerobic sediment off the Californias. Fish. Bull. 72: 257-273.
- Spalding, D. J. 1964. Comparative feeding habits of the fur seal, sea lion, and harbour seal on the British Columbia coast. Fish. Res. Bd. of Canada Bulletin 146: 1-52.
- Squire, J. L. Jr. 1972. Apparent abundance of some pelagic marine fishes off the southern and central California coast as surveyed by an airborne monitoring program. Fish. Bull. 70: 1005-1019.

- Squire, J. L. Jr. 1983. Abundance of pelagic resources off California, 1963-78, as measured by an airborne fish monitoring program. NOAA Technical Report NMFS SSRF-762: 75 p.
- Stewart, B. S. and R. L. DeLong. 1991. Double migrations and sexual segregation of foraging northern elephant seals. Abstracts: Ninth Biennial Conference on the Biology of Marine Mammals, December 5-9, 1991, Chicago, Illinois. p. 67.
- Stewart, B. S. and P. K. Yochem. 1985. Feeding habits of harbor seals (Phoca vitulina richardsi) at San Nicolas Island, California, 1980-1985. (Abstr.) Sixth Biennial Conf. on the Bio. of Mar. Mamm., November 22-26, 1985.
- Stroud, R. K., C. H. Fiscus, and H. Kajimura. 1981. Food of the Pacific white-sided dolphin, Lagenorhynchus obliquidens, Dall's porpoise, Phocoenoides dalli, and northern fur seal, Callorhinus ursinus off California and Washington. Fish. Bull 78: 951-959.
- Sverdurp, H. U., M. W. Johnson, and R. H. Fleming. 1942. The Oceans, their physics, chemistry, and general biology. Prentis-Hall, Inc. NJ. 1087 p.
- Swan, J. G. 1893. Notes on the fisheries and fishery industries of Puget Sound. Bull. U.S. Fish. Comm. Vol. 13, 371-80.
- SWFSC. 1991. Cruise report: Soviet research trawler, Novodrutsk. Southwest Fisheries Science Center Cruise Report. 10 p.
- Tagart, J. V. 1987. Description of the Washington State fishery for widow rockfish. p. 11-12. In: Lenarz, W. H., and D. R. Gunderson (ed.), Widow rockfish. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 48.
- Thomson, C. J. 1990. The market for fish meal and oil in the United States: 1960-1988 and future prospects. CalCOFI Rep. 31: 124-131.
- Thomson, C. J., C. Cooney, and J. Morgan. 1989. Status of the California coastal pelagic fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14.
- Thomson, C. J., and S. J. Crooke. 1991. Results of the Southern California sportfish economic survey. NOAA NMFS Technical Memorandum, NOAA-TM-NMFS-SWFSC-164. 264 p.

- Thomson, C. J., T. Dickerson, G. Walls, and J. Morgan. 1991. Status of the California coastal pelagic fisheries in 1990. NMFS, SWFSC Admin. Rep. LJ-91-22: 27 p.
- Thomson, C. J., and D. D. Huppert. 1987. Results of the Bay Area sportfish economic study (BASES). NOAA NMFS Technical Memorandum NOAA-TM-NMFS-SWFSC-78, 70 p.
- Tillman, M. F. 1977. Estimates of population size for the North Pacific Sei whale. Rep. Int. Whal. Commn. (Special Issue 1): 98-106.
- Tovar, H., V. Guillen, and M. E. Nakama. 1987. Monthly population size of three guano species off Peru, 1953 to 1982. ICLARM Studies and Reviews 15: 208-218.
- Tracey, S. D. 1985. Feeding habits of marine mammals from Grays Harbor, Washington to Netarb Bay, Oregon, p. 149-219. In: R. J. Beach, A. C. Geiger, S. J. Jeffries, S. D. Tracey, and B. L. Troutman. Marine mammals and their interactions with fisheries of the Columbia River and adjacent waters, 1981-1982. NWAFC Processed Report 85-04.
- Troadec, J. P., W. G. Clark, and J. A. Gulland. 1980. A review of some pelagic fish stocks in other areas. Rapp. P.-v. Réun. Cons. int. Explor. Mer, 177: 252-277.
- Turner, C. H. and J. C. Sexsmith. 1967. Marine baits of California. First revision. Calif. Dep. Fish Game, Sacramento, CA. 70 p.
- Ueber, E. 1988. The traditional central California setnet fishery. Mar. Fish. Rev. 50: 40-48.
- Urban, J., and A. Aguayo. 1987. Spatial and seasonal distribution of the humpback whale, Megaptera novaeangliae, in the Mexican Pacific. Marine Mammal Science 3: 333-344.
- U.S. Bureau of the Census. 1977. County business patterns, 1975, California. U.S. Government Printing Office. Washington, D.C.
- U.S. Bureau of the Census. 1982. County business patterns, 1980, California. U.S. Government Printing Office. Washington, D.C.
- U.S. Bureau of the Census. 1987. County business patterns, 1985, California. U.S. Government Printing Office. Washington, D.C.

- U.S. Bureau of the Census. 1988. County business patterns, 1986, California. U.S. Government Printing Office. Washington, D.C.
- U.S. Bureau of the Census. 1989. County business patterns, 1987, California. U.S. Government Printing Office. Washington, D.C.
- U.S. Bureau of the Census. 1990. County business patterns, 1988, California. U.S. Government Printing Office. Washington, D.C.
- Vrooman, A. M. 1964. Serologically differentiated subpopulations of the Pacific sardine, Sardinops caerulea. J. Fish. Res. Bd. Canada, 21: 691-701.
- Walford, L. A., and K. Mosher. 1941. Extension of pilchard spawning to north Pacific waters indicated. Pacific Fisherman. February, p. 47.
- Walker, W. A. 1981. Geographical variation in morphology and biology of bottlenose dolphins (Tursiops) in the eastern North Pacific. NMFS Admin. Rep. LJ-81-03C, 17 p.
- Walker, W. A., K. R. Goodrich, S. Leatherwood, and R. K. Stroud. 1984. Population biology and ecology of the Pacific white-sided dolphin, Lagenorhynchus obliquidens, in the Northeastern Pacific. Part II: Biology and geographical variation. NMFS Admin. Rep. LJ-84-34C, 39 p.
- Wells, R. L., L. J. Hansen, A. Baldrige, T. P. Dohl, D. L. Kelly, and R. H. Defran. 1990. Northward extension of the range of bottlenose dolphins along the California coast. p. 421-431. In: S. Leatherwood and R. Reeves [ed.] The bottlenose dolphin. Academic Press, Inc., New York, New York.
- Wolf, P. 1989. Status of the Pacific mackerel populations, 1989. Calif. Dep. Fish Game, Legislative Rep. 20 p.
- Wolf, P., and P. E. Smith. 1986. The relative magnitude of the 1985 Pacific sardine spawning biomass off southern California. CalCOFI Rep. 27: 25-31.
- Wolf, P., P. E. Smith, and C. L. Scannell. 1987. The relative magnitude of the 1986 Pacific sardine spawning biomass off California. CalCOFI Rep. 28: 21-26.

